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# U.S. COAST GUARD HUMAN SYSTEMS INTEGRATION (HSI) PROCESS MODEL



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Research and Development Center
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and

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United States Coast Guard
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A review of the Coast Guard acquisition process was completed in phase one of this effort, "U.S. Coast Guard Human Systems Integration Program Requirements Document," report number R&DC 10/94. The Coast Guard technical contact and COTR is Dr. Antonio B. Carvalhais, (203) 441-2846.

16. Abstract

The Coast Guard has identified a need to improve Human System Integration (HSI) in the planning, design, and development of new system acquisitions. A previous effort, "U.S. Coast Guard Human Systems Integration Program Requirements Document," revealed that HSI principles are not consistently applied throughout the acquisition process, and that a formal HSI program would ensure that human related issues are addressed during new system acquisitions. This report provides a recommended "Process Model" for integrating the various elements of HSI (i.e., Manpower, Personnel, Training, Human Factors Engineering, and Safety/Health Hazards) into all new Coast Guard hardware acquisitions, including ships, aircraft, and all equipment/systems/subsystems fielded through the acquisition program. An evaluation was conducted to assess the strengths and weaknesses of existing HSI programs and determine whether elements of existing programs could be used in the Coast Guard environment. Based on this review, a process model was developed to integrate HSI into the Coast Guard acquisition process.

17. Key Words

Human System Integration (HSI), manpower, personnel, training, human factors engineering, safety and health, acquisition system, life-cycle costs, integrated logistical support, baseline comparison, front-end analysis

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# METRIC CONVERSION FACTORS

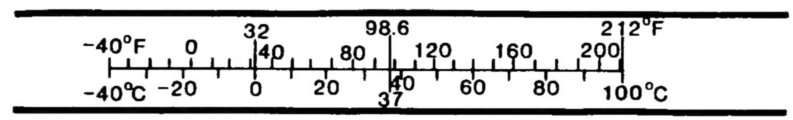
## Approximate Conversions to Metric Measures

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| in | inches | *2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | kilometers | km |
| | | **AREA** | | |
| $in^2$ | square inches | 6.5 | square centimeters | $cm^2$ |
| $ft^2$ | square feet | 0.09 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.8 | square meters | $m^2$ |
| $mi^2$ | square miles | 2.6 | square kilometers | $km^2$ |
| | acres | 0.4 | hectares | ha |
| | | **MASS (WEIGHT)** | | |
| oz | ounces | 28 | grams | g |
| lb | pounds | 0.45 | kilograms | kg |
| | short tons (2000 lb) | 0.9 | tonnes | t |
| | | **VOLUME** | | |
| tsp | teaspoons | 5 | milliliters | ml |
| tbsp | tablespoons | 15 | milliliters | ml |
| fl oz | fluid ounces | 30 | milliliters | ml |
| c | cups | 0.24 | liters | l |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.95 | liters | l |
| gal | gallons | 3.8 | liters | l |
| $ft^3$ | cubic feet | 0.03 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.76 | cubic meters | $m^3$ |
| | | **TEMPERATURE (EXACT)** | | |
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |

*1 in = 2.54 (exactly).


## Approximate Conversions from Metric Measures

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| mm | millimeters | 0.04 | inches | in |
| cm | centimeters | 0.4 | inches | in |
| m | meters | 3.3 | feet | ft |
| m | meters | 1.1 | yards | yd |
| km | kilometers | 0.6 | miles | mi |
| | | **AREA** | | |
| $cm^2$ | square centimeters | 0.16 | square inches | $in^2$ |
| $m^2$ | square meters | 1.2 | square yards | $yd^2$ |
| $km^2$ | square kilometers | 0.4 | square miles | $mi^2$ |
| ha | hectares (10,000 $m^2$) | 2.5 | acres | |
| | | **MASS (WEIGHT)** | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.2 | pounds | lb |
| t | tonnes (1000 kg) | 1.1 | short tons | |
| | | **VOLUME** | | |
| ml | milliliters | 0.03 | fluid ounces | fl oz |
| l | liters | 0.125 | cups | c |
| l | liters | 2.1 | pints | pt |
| l | liters | 1.06 | quarts | qt |
| l | liters | 0.26 | gallons | gal |
| $m^3$ | cubic meters | 35 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.3 | cubic yards | $yd^3$ |
| | | **TEMPERATURE (EXACT)** | | |
| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |



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# COAST GUARD HSI PROCESS MODEL

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# INTRODUCTION

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# SECTION A
# INTRODUCTION

1. WHAT IS A HUMAN SYSTEMS INTEGRATION (HSI) PROCESS MODEL? A "process" can be defined as a series of actions, changes, or functions that bring about an end result. An HSI Process Model describes those specific actions that must be accomplished in each domain across the seven Coast Guard acquisition phases to ensure that human issues are identified, addressed, and managed throughout the design, development, and support of a new materiel system.

2. BACKGROUND. The HSI Program Requirements Document, developed during Task A of this project, introduced the Coast Guard to the many advantages of the HSI Program and the substantial cost and performance benefits available by implementing HSI in the Coast Guard acquisition system. A number of deficiencies were identified in previous acquisitions that could have been minimized or avoided if the principles of the HSI Program had been followed. Task A has clearly established the need for an effective HSI Program in the Coast Guard acquisition process.

Development of the Coast Guard HSI Process Model in Task B is the next logical step to further refine the HSI Program for Coast Guard evaluation. This model provides the next level of detail in describing how the Coast Guard should design and manage each domain to achieve the objectives of HSI within the boundaries of the acquisition process. The model recommends a series of action steps that define a specific process in each domain, and the total processes have been tailored to meet requirements and timing of the seven phases and four Key Decision Points (KDPs) in the Coast Guard acquisition system.

The HSI Process Model has been designed using the best features of the Department of Defense (DoD) HSI Programs developed over the past 10 to 15 years by the individual DoD Military Services. This allows the Coast Guard to take advantage of lessons learned from these previous development efforts and to avoid much of the costly and time-consuming false starts associated with developing a new program from the ground up. In developing this HSI Process Model, we have tailored proven techniques and processes to the specific Coast Guard needs in each domain, thereby creating a uniquely Coast Guard HSI Program.

Accordingly, this document describes the basis for the HSI Process Model, as well as the methodologies and specific processes recommended to fully integrate HSI into the Coast Guard acquisition process. Following this introduction, Section B will describe the DoD HSI programs used and the rationale for selecting each process as the basis for the Coast Guard HSI Process Model. Section C details the recommended management structure needed to manage HSI through each phase of the acquisition process. Section D describes the processes recommended as the Coast Guard model in implementing HSI, including the data bases required, content of the essential Front-End Analysis (FEA), how to write hardware/software contractor Requests for

Proposals (RFPs) to include HSI, and a discussion of cost determination; Section D concludes with a description of the recommended processes in each HSI domain. Section E discusses how HSI fits into alternative acquisition strategies, including the tailoring of traditional full development procurements, materiel changes, non-developmental item acquisitions, and streamlining in all strategies. The document concludes with recommendations in Section F for assignment of specific Headquarters Staff organizations to manage implementation of HSI. A list of references is included at Appendix A and acronyms at Appendix B. Additionally, a description of HSI in the Department of Defense and the Military Departments is included as an Attachment at the end of this document.

## SECTION B
## DESIGN OF THE MODEL

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## SECTION B
## DESIGN OF THE MODEL

1. DEPARTMENT OF DEFENSE MILITARY SERVICES HUMAN SYSTEMS INTEGRATION (HSI) MODELS. We reviewed the major DoD Military Service HSI Models, analyzed the various management and domain processes they use, and evaluated how well the strongest of those processes fit with the Coast Guard acquisition system in developing a unique Coast Guard HSI Process Model. We also identified DoD model commonalities, primary strengths of the collective models, and strengths/weaknesses of the individual DoD models.

1.1 Major HSI Models Reviewed. Since February 1991, all DoD Services have been required to include all five domains in each system acquisition. The following HSI Modelswere reviewed.

a. Army Manpower and Personnel Integration (MANPRINT) Program. Army pioneered development of six MANPRINT domains and was the model on which DoD chose to base the HSI Program. Among the DoD Services, MANPRINT has the most mature process in the Human Factors Engineering (HFE) and System Safety/Health Hazard (SS/HH) domains.

b. Navy Military Hardware/Manpower Integration (HARDMAN) Program. HARDMAN is designed to determine Manpower, Personnel, and Training (MPT) domain requirements only. HFE and SS/HH domains have been included in Navy Procurements for the past several years by some Navy Systems Commands for acquisitions in their functional areas. Unfortunely, not all Navy functional areas have been included, and the HSI domains have not been integrated. Secretary of the Navy (SECNAV) Instruction 5000.2A has recently been approved to implement defense acquisition management policies and procedures. This instruction reaffirms use of the HARDMAN methodology for MPT domains and, additionally, requires that HFE and SS/HH domains be integrated into all system acquisitions.

c. Air Force Integrated Manpower, Personnel, and Comprehensive Training and Safety (IMPACTS) Program. This program is aimed at standardizing and integrating all HSI activity. Over the past several years, each individual Major Command in the Air Force has developed their own acquisition processes. This has resulted in little standardization and an acquisition system with components that are not integrated. The process has generally, but sometimes inconsistently, used all HSI domains and is more automated than the other service programs.

d. U.S. Marine Corps. The Marines also has an HSI program, but it is not substantially different from the Navy program.

1.2 Program Commonality. In evaluating the effectiveness of each Services' HSI Model, we found the following commonality between the models.

a. An identifiable program

b. Specific governing directives

c. The manpower and personnel communities have significant roles in the HSI program

d. Program/Project Managers are tasked to include HSI in design of major acquisition projects

e. Comparability analysis is the primary analytical technique used

f. Training is provided for HSI analysts

g. Programs are all relatively new

h. Programs are growing, but at different rates

1.3 Primary Strengths in DoD HSI Models. Each DoD HSI model varies in how much it contributes to the acquisition process. Following are the primary elements of strength that the collective programs exhibit.

a. Perhaps the most critical strength to long-term success is strong, sustained support for HSI from the organizations executing the program. Both senior level and grass roots support are important. Senior-level support facilitates quick program starts, but grass roots support sustains the program over the long term.

b. Adequate resource support is critical in both funding and staff personnel. This is especially true in establishing the initial HSI Program and in coordinating Front-End Analysis (FEA). Without this support, HSI cannot impact system design.

c. Strong technical programs and sound program strategy produce credible results that avoid costly alterations and redesigns.

d. Programs that are well documented down to an analyst level of detail prevent the analyst from "reinventing the wheel" on each acquisition.

e. Mandatory use of HSI principles in all acquisitions is necessary and must be enforced to prevent redistribution of HSI resources to other priorities.

f. Strong HSI Program identity is a must, and it should be separate from the Integrated Logistics Support (ILS) organization (although products and data are coordinated with ILS).

g. The manpower and personnel community must have meaningful roles. These two communities are the traditional institutional representatives of Manpower, Personnel, and Training.

h. A strong commitment to HSI in source selection and contracting specifications is required to send a clear message to industry that the Coast Guard is serious about wanting HSI to influence system design.

1.4 Strengths and Weaknesses in DoD Service HSI Models. The systemic strengths/weaknesses discussed here are based on needs of the Service, how well each program meets DoD requirements, and the compatibility of these programs with the Coast Guard acquisition process.

1.4.1 Army MANPRINT Program. This is the most complete and generally recognized as the strongest overall HSI Program in DoD. In maturity, MANPRINT is 9 years old in name, 8 years old in planning, 7 years old in training, and 6 years old in documentation. A more complete description of the MANPRINT Program is included in Appendix C.

1.4.1.1 Critique of MANPRINT Systemic Processes.

a. MANPRINT Program Strengths.

(1) There has been strong senior level support from program inception in 1983 (program was officially promulgated in 1984), and popular grass roots support as well.

(2) In evaluation criteria for Request for Proposal (RFP) source selections, MANPRINT has been designed as a separate major area having equal weight with technical, management, and cost in the evaluation process.

(3) Requirements of MANPRINT in RFPs have impacted the award of several major contracts. This commitment has industry attention.

(4) MANPRINT has strong program identification separate from ILS and has provided a meaningful role for the manpower and personnel communities.

(5) The program is sponsored by a single organization at the Headquarters level.

(6) MANPRINT is managed through each acquisition by a MANPRINT Joint Working Group (MJWG) co-chaired by the Combat Developer (the user or user representative) and the Materiel Developer (the Army Materiel Command) assigned to design and develop the new materiel. MJWG is Army's executive agent responsible for identifying, analyzing, resolving, and documenting all HSI issues during system acquisition. This management process brings together all the right organizations to focus Army expertise in solving each specific acquisition's problems.

(7) MANPRINT domain expertise is institutionalized among several large Army organizations. This permits these organizations to support the HSI Program with required expertise as a normal part of their daily business.

(8) The MANPRINT Program starts at project initiation and makes major inputs in all domains to design and development of each new acquisition. The Program also provides a systematic approach to developing affordable and supportable life-cycle MPT requirements.

(9) Army institutional organizations maintain HSI lessons learned and other applicable documentation external to individual acquisitions. They also maintain historical records of each acquisition.

(10) Army has designated Director of Information Systems for Command, Control, Communications, and Computers (DISC-4) to establish MANPRINT policy and guidance for the acquisition of management information systems.

b. MANPRINT Program Weaknesses.

(1) Under-funding of Front-End Analyses continues to be a problem. This is primarily because of a lack of appreciation, among people responsible for funding FEA, for the critical role FEA plays in the HSI Program during the very earliest phases of the new acquisition. Unfortunately, if the window of opportunity to make meaningful input to major system documentation that drives the design process is missed, there are no inexpensive ways to catch up later in the acquisition.

(2) The validity of analytical techniques, adequacy of data, and identification of essential elements of information varies by MANPRINT functional area and should be improved in most areas.

1.4.1.2 Critique of MANPRINT Domain Processes.

a. Human Factors Engineering. MANPRINT has the oldest HFE program and the most HFE experience on actual procurements of any DoD program.

(1) The HFE domain is fully integrated into system and design engineering for maximum impact on system design. HFE also functions as the lead domain, coordinating with other domain specialists to find solutions to HSI problems that may impact system design, and then coordinating the recommended solutions with system and design engineers to make corrections in the proposed design.

(2) HFE work in acquisitions is mostly done in-house by the Army Human Engineering Laboratory or the Army Research Institute. This promotes continuity from one procurement to the next and aids in developing a comprehensive lessons learned data base for use in improving HFE inputs to future acquisitions.

(3) MANPRINT was the first DoD system to recognize the impact of human performance on total system reliability. The Army system has pioneered development of HFE applications to military hardware design. Over time, this system has developed into a complete program, covering all aspects of HFE from development of human performance criteria and constraints to testing the design for performance shortfalls.

(4) The MANPRINT HFE domain has not been applied to vessels the size of Coast Guard cutters and generally not to larger aircraft.

b. System Safety/Health Hazards. MANPRINT splits System Safety and Health Hazards into two distinct domains (for a total of six domains). This is primarily because there are two separate Army institutional organizations responsible for these functional areas: the Army Safety Center handles System Safety, while the Army Surgeon General is responsible for Health Hazards.

(1) MANPRINT primarily uses the DoD Military Standard 882B, entitled System Safety Program Requirements, to meet the needs of both System Safety and Health Hazards.

(2) The SS and HH domains in MANPRINT are relatively mature and offer a complete program from identification of SS/HH objectives and review of lessons learned to test and evaluation of the new design. Both SS and HH criteria are applied to all design changes to ensure the final design is safe and hazard free.

c. Manpower, Personnel, and Training. While each of these domains is distinct, MANPRINT intertwines MPT into the process such that it is expedient to evaluate the MPT domains as part of a single process.

(1) The strongest feature of the MANPRINT MPT process is development of a Target Audience Description (TAD) to tie the HSI process specifically to the system design. This TAD is a direct human criteria input to the hardware/software contractor who will design and build the new acquisition. The TAD describes the capabilities and limitations of the people who will be available to operate, maintain, train, and otherwise support the new procurement when fielded. Not only are these design criteria passed officially to the contractor, but the new design is tested and evaluated to ensure the design meets the human specifications. If not, the contractor will have to redesign the system until the human criteria are met.

(2) All commands in the Army with any responsibility for MPT in acquisitions are brought together by the MANPRINT Joint Working Group. The MJWG is a way to focus Army institutional expertise on solving MPT problems in individual procurements. MJWG management of the MPT process through all phases of each acquisition is another strong feature of the MANPRINT program.

(3) MANPRINT MPT analytical tools are data intensive, requiring considerable time, effort, and cost before the models can be run. Then several iterations are sometimes required before a final output is completed.

1.4.2 Navy HARDMAN Program. The Navy HARDMAN Program is the oldest MPT program in DoD having originated in its initial form in 1976. The program has a reputation for having sound analytical approaches and a systematic process for determining life-cycle MPT requirements in the design of new procurements. A description of the Navy HARDMAN Program, plus the Navy program to include Human Factors Engineering and System Safety/Health Hazard domains in system acquisitions, is presented in Appendix D.

1.4.2.1 Critique of Navy HARDMAN Systemic Processes.

a. HARDMAN Program Strengths.

(1) HARDMAN has valid and proven analytical techniques in the MPT domains. This solid technical program produces sound, credible MPT life-cycle requirements.

(2) HARDMAN provides systematic approaches to defining MPT life-cycle requirements in each acquisition.

(3) Navy Systems Commands have been using and perfecting HFE and SS/HH techniques in ships and aircraft for the past several years. SECNAVINST 5000.2A formalizes and integrates an on-going process.

(4) HARDMAN Methodology focuses Navy institutional expertise on solving MPT issues in individual acquisitions.

(5) HARDMAN provides a meaningful role for the manpower and personnel communities.

(6) This program is well documented down to the analyst level of detail.

b. HARDMAN Program Weaknesses.

(1) High-level and Systems Command support for HARDMAN has been weak and inconsistent. HFE and SS/HH has considerable grass roots support but is primarily driven at higher levels by DoD requirements.

(2) Mandatory use of HARDMAN in all acquisitions has not been enforced. Systems Command PMs determine timing, funding, and depth of HARDMAN analyses, but may be motivated to trade-off HARDMAN resources in favor of other cost, schedule, and performance needs. Funding for Front-End Analysis has been insufficient, primarily for this reason.

(3) HARDMAN is not well integrated with system/design engineering and concentrates more on identifying MPT requirements of the completed system than on impacting system design.

(4) Responsibility for HARDMAN is still fragmented with no single organization responsible for the entire program.

1.4.2.2 Critique of Navy HARDMAN Domain Processes. The HARDMAN Methodology focuses on the MPT domains and does not address Human Factors Engineering or System Safety/Health Hazards. In response to DoD Instruction 5000.2 dated February 23, 1991, the Navy has issued SECNAV Instruction 5000.2A that requires HFE and SS/HH to be included in system design. The SYSCOMs have used HFE and SS/HH inputs to some degree in most procurements for the past few years. The following paragraphs describe the status of the HSI domains in Navy acquisition with a view toward potential benefits to the Coast Guard in starting up an HSI Program.

a. Human Factors Engineering. This domain has been discussed in Navy acquisition directives in the past, but HFE has not been particularly emphasized in most Navy procurements. Both the Naval Air and Naval Sea Systems Commands have used HFE in the design and development of aircraft and ships. Both Systems Commands have developed process models to guide the integration of HFE specifically into ship and aircraft designs. Neither SYSCOM is using a complete HFE program to include an HFE plan for each acquisition, analyses to determine optimum man-machine interface, test and evaluation of the completed design, and follow-up to ensure all required HFE changes have been incorporated in the deployed system. HFE has not been a significant part of the source selection/contract award process in Navy acquisitions. Some lessons learned experience has been documented from these HFE applications.

b. System Safety/Health Hazards. Navy acquisition directives have required that a minimum SS/HH program be included in system acquisitions. This has been done by requiring hardware/software contractors to comply with Military Standard 882B. In addition, some segments of the Navy (such as the submarine force) have been on the leading edge of safety innovation for several years. Lessons learned have been documented for ship and aircraft procurements.

c. Manpower, Personnel, and Training. These domains have been required by Navy acquisition directives as part of the Integrated Logistics Support Plan (ILSP). HARDMAN Methodology is used by the PM staff (or by contractor) to determine MPT requirements for each acquisition. The HARDMAN directive was developed and is sponsored by the Chief Naval Operations (CNO) staff office responsible for MPT (i.e., OP-01). Since OP-01 has no responsibility for acquisition, the Methodology is focused on determining MPT requirements for the completed acquisition, rather than emphasizing manpower savings through better engineering design or other ways to impact system design. To offset this bias in the Methodology, close coordination is required between the Program Manager's staff (or contractor) conducting the HARDMAN Methodology and the SYSCOM design engineering organizations responsible for system design.

The HARDMAN Methodology uses the Navy Training Plan (NTP) process to formally approve all MPT requirements for each acquisition. The Program Manager's staff (or contractor) documents the manpower and personnel requirements in the NTP and uses them as inputs to develop the training requirements. The documented MPT requirements from the Program Manager's staff are approved by the Navy institutional organization responsible for MPT (i.e., OP-01). The approved NTP is used by OP-01 to provide life-cycle MPT support to the new acquisition.

1.4.3 Air Force IMPACTS Program. This program is a follow-on to the Readiness Achieved Through Manpower, Personnel, and Requisite Training and Safety (RAMPARTS) Program.

1.4.3.1 Critique of Air Force IMPACTS Systemic Processes.

a. IMPACTS Program Strengths.

(1) A model organization has been established at Wright Patterson Air Force Base to institutionalize IMPACTS at the engineering level. This is a strong point because HSI must impact system design through the engineering organization responsible for the design. Accordingly, most HSI-to-engineer interface problems would be solved by institutionalizing HSI at the engineering level.

(2) The IMPACTS Program includes advanced models in most functional areas. These automated models have been developed over a number of years and are quite mature.

b. IMPACTS Program Weaknesses.

(1) Air Force HSI is not integrated and approaches are not cohesive or consistent. Each Major Command has developed its own models and procedures. IMPACTS is meant to standardize and integrate the HSI Program.

(2) High-level support for IMPACTS has been weak. The IMPACTS directive has been in draft since October 1988 and was only recently approved.

(3) Analytical models are non-standard, and their use is decentralized and inconsistent.

1.4.3.2 Critique of Air Force IMPACTS Domain Processes. When the Air Force recently approved the IMPACTS Program directive, we found it to have insufficient detail to

adequately critique how the IMPACTS Program handles individual domain processes. Consequently, our recommendations for the Coast Guard HSI Process Model does not include any specific Air Force Model strengths.

1.5 Rationale for Selecting the Coast Guard Model in Each Domain. Based on our review of existing models, we have developed a unique for Coast Guard Process Model using the following criteria:

a. Specific characteristics or elements providing the best fit for tailoring HSI to the Coast Guard acquisition process with the least disruption, while retaining maximum effectiveness.

b. Strengths and weaknesses of existing HSI models.

c. Models offering the most cost saving/cost avoidance and best timeliness.

d. Coast Guard similarities in materiel systems, personnel structure, operating environment, and maintenance/training requirements.

# SECTION C
# COAST GUARD MANAGEMENT SYSTEM

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# SECTION C
# COAST GUARD MANAGEMENT SYSTEM

1. INTRODUCTION. This section describes how the recommended management process should work in the Coast Guard acquisition system. The management system described here is the day-to-day activity required to manage Human Systems Integration concerns throughout an individual acquisition. The philosophy of the Coast Guard HSI Program should be to require industry and the acquisition system to answer the following question on each acquisition, "Can this Coast Guardsman with this training perform these tasks to these standards under these conditions?"

We begin by listing the objectives the Coast Guard HSI management system should strive to achieve. Then we describe how the management structure will work, including the specific duties performed by the office responsible for the HSI Program (OHSIP), the System Management Plan, and HSI Reviews and Assessments. We end this section with a discussion of the various interfaces necessary to ensure a smooth and orderly implementation of the HSI Program.

2. COAST GUARD HSI MANAGEMENT SYSTEM OBJECTIVES. In managing HSI through each acquisition, the management system is striving to achieve the following objectives:

a. Include HSI considerations as a major "Source Selection Criteria" to be used in evaluating contractor proposals.

b. Develop equipment that permits human-materiel interaction within human physiological tolerance limits, training time, personnel aptitudes and skills.

c. Develop, maintain, and use data bases containing human factors, human performance, manpower, personnel, training, system safety, and health hazard information. This includes lessons learned in each domain and a historical file for use in future acquisitions.

d. Conduct Front-End Analysis early enough in the process to develop HSI constraints in each domain, performance criteria, and other inputs to all major program documentation, including the Mission Need Statement, strategy objectives for the Acquisition Plan, Preliminary Operational Requirements Document, Project Management Plan, Test and Evaluation Master Plan, and Integrated Logistic Support Plan (ISLP).

e. Provide HSI inputs in all appropriate parts of Requests for Proposals for hardware/software contractors.

f. Select, define, and develop human-materiel interface characteristics, work space layout, work environment, and effective transfer of operator-maintainer skills for similar tasks or similar equipment.

(1) Developing and defining a work environment includes detailed analyses of the impact the proposed environment has on the health and safety of operator, maintainer, and support personnel.

(2) Analyses of the work environment also includes consideration of the physical and cognitive demands on personnel based on the operating tempo of the assigned unit in both training and operational environments.

g. Determine human performance requirements for new systems and match available human aptitudes with appropriate training concepts (including training devices, simulators, and publications) to produce required skills.

h. Determine the numbers and types of active duty, reserve, and civilian personnel required to man new acquisitions and provide for subsequent personnel planning and training. Determine affordability and supportability of the manpower and personnel required.

(1) Provide data necessary to establish new military occupational specialties and qualification identifiers, as required.

(2) Evaluate Coast Guard's ability to support personnel and training requirements in the timeframes needed to meet planned deployment dates of the new system.

i. Provide HSI assessments for Key Decision Point (KDP) reviews.

j. Assess the sensitivity of the system's design, cost, and performance to the assumptions, estimates, and variations in human dimensions of the system.

k. Perform test and evaluation to determine that the design meets HSI standards in each domain.

l. Provide follow-up before the system is deployed to ensure that all HSI criteria have been met in the system design and development.

3. <u>DESCRIPTION OF RECOMMENDED MANAGEMENT STRUCTURE</u>. The Coast Guard management system should be headed by the office responsible for the HSI Program and should include the following elements: HSI System Management Plan, HSI Reviews, and HSI Assessments. Exhibit C-1 displays these management elements. The following paragraphs describe how each of the elements fit into the management structure.

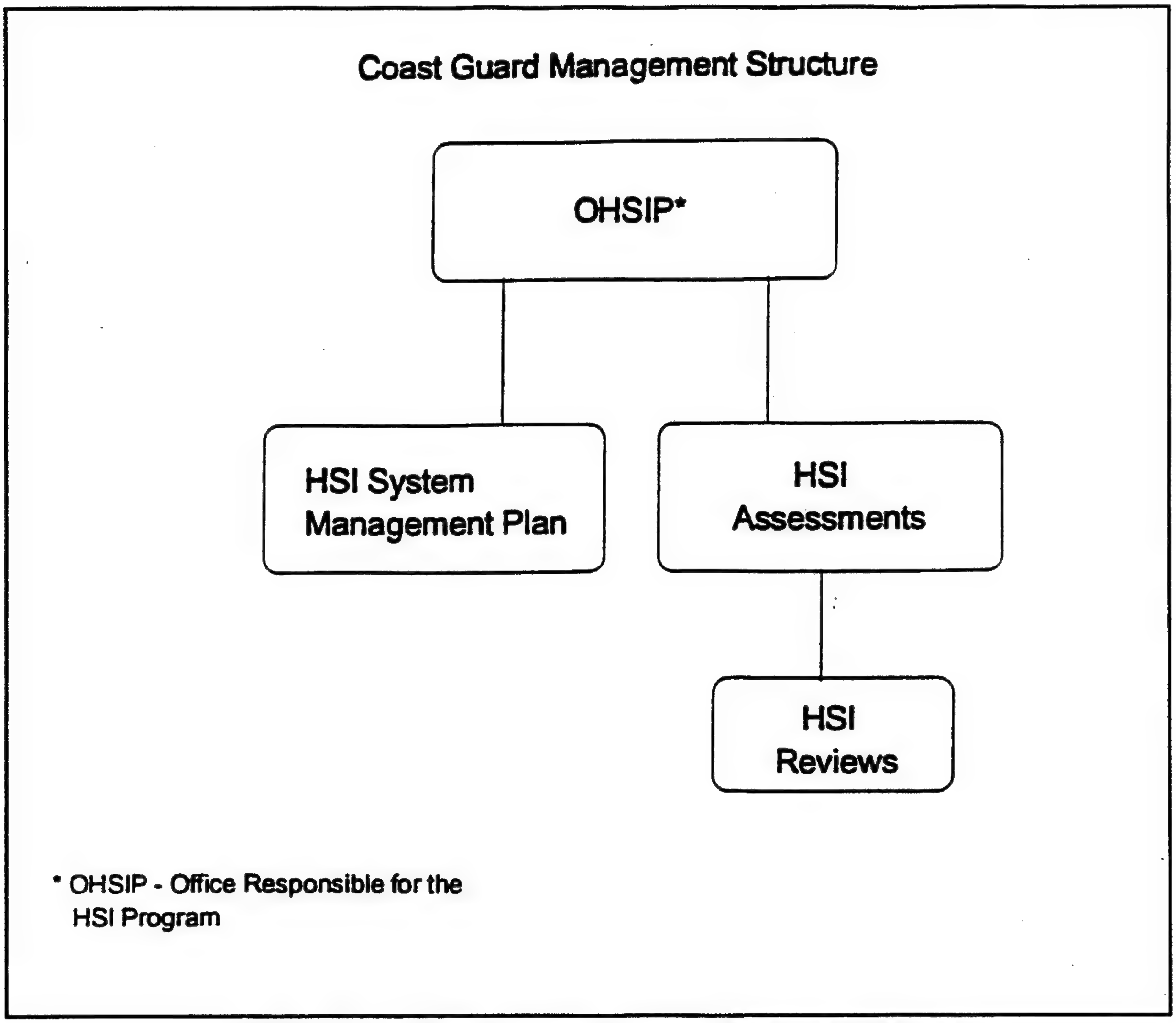


**Exhibit C-1. Tools Used to Manage HSI in Individual Coast Guard Acquisitions**

3.1 <u>OHSIP Management Responsibilities</u>. The OHSIP is responsible for planning and executing all facets of the HSI Program for each domain in each acquisition phase. The following are basic responsibilities of the OHSIP in carrying our these duties.

a. Writing the HSI System Management Plan — See paragraph 3.2 in this section and Appendix E for further details.

b. Developing the Target Audience Description (TAD) — The TAD describes numbers and quality of personnel force anticipated when the new system is fielded. See the HSI System Management Plan Tab E, in Appendix E, for further details.

c. Developing HSI criteria, constraints, and objectives for inclusion into major program documents. This information is developed from the Front-End Analysis. The OHSIP is the focal point for system HSI issues and criteria during formulation of the Mission Need Statement, Operational Requirements Document, Acquisition Plan, Program Management Plan, Test and Evaluation Master Plan, and Integrated Logistic Support Plan.

d. Planning for and managing HSI analyses, including:

(1) Early Front-End Analysis — The FEA develops initial estimates of manpower and HSI constraints/criteria in all domains for inclusion into major program documents.

(2) Cost Benefit Analysis (CBA) — This is a systematic and formal economic analysis of the relationship between life-cycle cost and the operational effectiveness of each alternative solution to the mission need. While the PM conducts this analysis, the MPT costs are one of the prime considerations.

(3) Life-Cycle Cost Estimate (LCCE) — The LCCE is developed to identify the total cost to the Government of an item or system over its useful life. MPT costs are usually major inputs. This estimate is first computed for KDP-2 in the Concepts Exploration Phase and is updated in each succeeding phase. By Full Scale Development, the life-cycle cost transitions from primarily a design element to a control element for the project.

(4) Trade-Off Analysis (TOA) — This analysis is conducted by the PM with inputs from the Program Sponsor and the office responsible for the HSI Program.

(a) TOA may include the following:

1 Mission and performance rationale

2 Analysis of system trade-offs

3 Selection of best technical approach from an operational and logistical standpoint

(b) The TOA identifies critical design factors and potential HSI cost drivers.

e. Producing the HSI Test and Evaluation Program — HSI test and evaluation looks beyond individual domain requirements at total operational capability.

(1) The OHSIP forms a Test Integration Working Group (TIWG) to coordinate HSI testing. The TIWG is tailored to match the size and complexity of the acquisition. The following are characteristics of the TIWG:

(a) This working group is formally chartered by the OHSIP.

(b) It is chaired by the office responsible for the HSI Program.

(c) Membership in TIWG includes representatives from the Program Sponsor, logistician, operational tester, and when appropriate, the hardware contractor.

(d) The primary purpose of TIWG is to direct communications to facilitate integration of test requirements and speed up the test coordination process.

(e) The objective of TIWG is to reduce costs by integrating testing to the maximum extent, eliminating redundant testing, and facilitating the coordination of test planning, interchange of test data, and use of test resources.

(2) TIWG develops the HSI portion of the Test and Evaluation Master Plan (TEMP). The TEMP is the basic planning document that identifies critical technical and operational issues and all planned test activities. Human performance concerns in the HSI System Management Plan should be included as issues in the TEMP. Tests must be designed so that accurate, quantitative (measurable) data that addresses total system performance can be gathered and evaluated. Remember that the only tests likely to be done are those included in the TEMP.

f. Ensuring Human Factors Engineering principles are applied throughout the acquisition process and specifically to the following areas:

(1) System mission analysis

(2) Determination of system functional requirements and capabilities

(3) Allocation of system functional requirements to human/hardware/software

(4) Development of system functional flows

(5) Performance of system effectiveness studies

(6) Test and mock-up evaluations

(7) Dynamic simulations

(8) Detail drawing reviews

(9) System design reviews

(10) System/equipment/component design and performance specification preparation and review

g. The office responsible for the HSI Program has the option of establishing an HSI Joint Working Group (HSIJWG), as described in Appendix L, when dealing with an acquisition posing sufficiently complex HSI issues that use of a HSIJWG would be beneficial to properly accommodate all the issues.

3.2 HSI System Management Plan HSISMP. This is a planning and management guide used by the OHSIP as a living planning and management record of all HSI plans, issues, and actions taken to address HSI concerns throughout the new system's acquisition

a. The HSISMP is the first program management document in the entire acquisition cycle. It is prepared jointly by the Program Sponsor, Project manager, and the office responsible for the HSI Program, and it addresses domain-specific issues. The emphasis in the HSISMP changes at KDP-2, as described below.

(1) Prior to Key Decision Point 2, the emphasis is on influencing design decisions by making key HSI inputs to major program documents that drive and shape the system design. Actions include identifying existing guidance, predecessor systems, data sources, areas of concern, and analyses that will be required (especially the very early analyses that develop constraints and performance criteria).

(2) After Key Decision Point 2, the emphasis shifts to system operational supportability from a Manpower, personnel, and Training (MPT)

perspective; resolution of HSI issues; and integration of human performance issues in other system documents (e.g., technical manuals and operator guides) to achieve system HSI objectives.

b. The HSISMP documents data that are available, or data that must be generated, indicating how, when , and by whom the data will be developed. In addition, the plan documents how data will be used to address HSI issues and concerns.

c. The HSI System Management Plan provides a comprehensive audit trail that documents HSI data sources, analyses, trade-offs, and decisions made throughout the acquisition process. The plan also serves as documentation of what was considered and why it was or was not used. This plan provides continuity in the HSI acquisition process from one phase to the next.

d. The HSISMP is reviewed and approved by the Program Sponsor, Project manager, and the office responsible for the HSI Program prior to each Key Decision Point.

e. The HSISMP is structured in seven sections as shown in Appendix E.

3.3 <u>HSI Reviews and Assessments</u>. Reviews and assessments are conducted to determine the status and adequacy of HSI effort and to present and unresolved HSI issues or concerns to decision makers.

a. Reviews are held in conjunction with ILS Management Team reviews of the system. They are done by the PM for all acquisitions, and the results are documented in the HSISMP.

b. Assessments are done prior to each Key Decision Point review on all acquisition programs. Assessments are conducted jointly by the Program Sponsor and the Office of Acquisition. The results are documented in the HSISMP and presented at each KDP review.

4. <u>INTERFACES NECESSARY</u>. To promote a smooth functioning and well-integrated HSI Program, the office responsible for the HSI Program must establish win-win relationships with the various organizations that support HSI in the acquisition process. See Exhibit C-2. The following interface parameters must be identified and mutually agreed to by each organization involved:

a. Responsibilities of both parties to the interface for the various elements of HSI in the acquisition process

b. Exchange of necessary information, data, documents, etc.

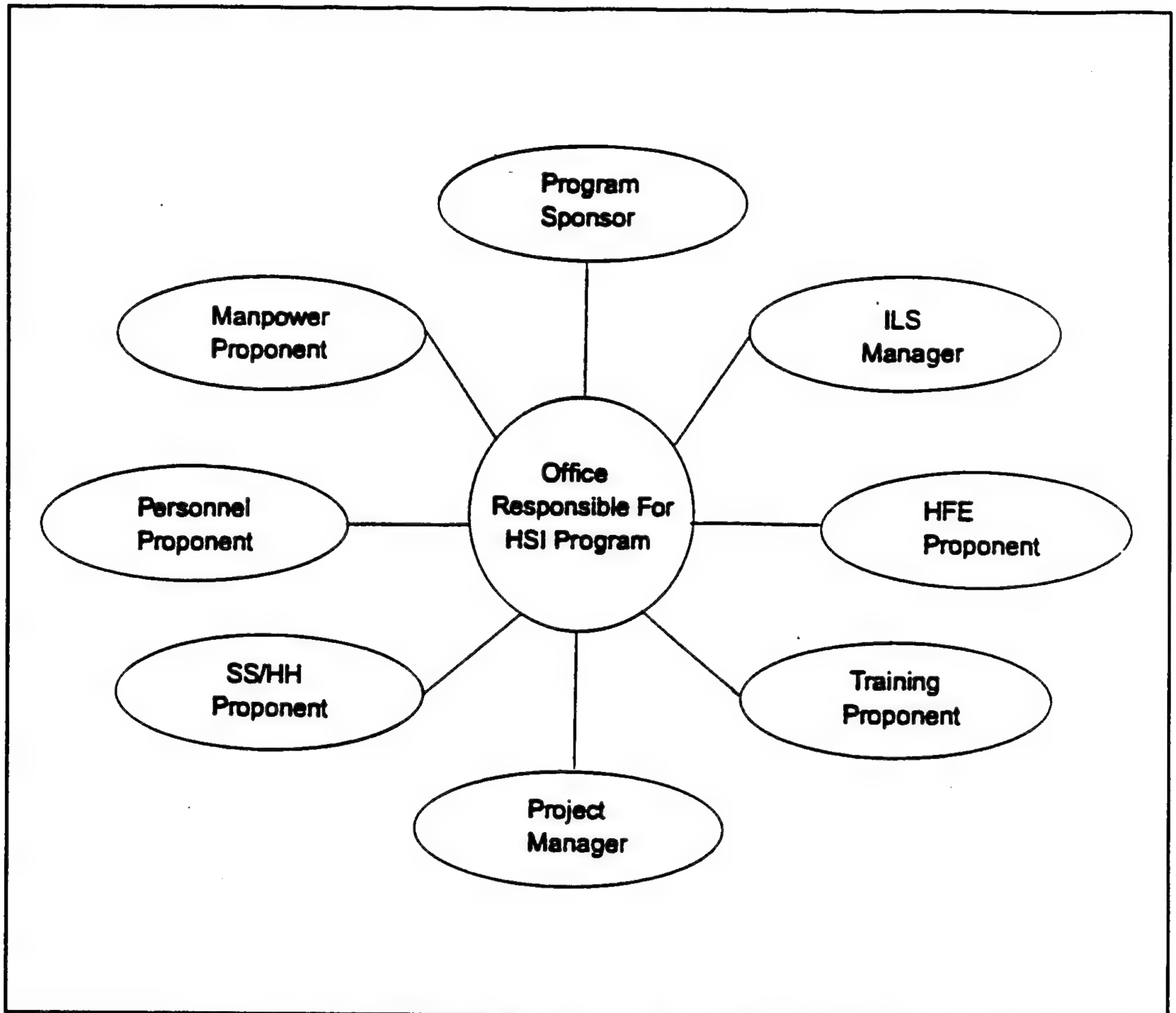


**Exhibit C-2. Interfaces Required to Execute the HSI Program**

c. Coordination/communications required to properly execute the HSI Program

The following paragraphs describe the interface parameters required between the office responsible for the HSI Program and the organizations with specific HSI responsibilities or having data/other inputs needed to effectively carry out the HSI Program in the acquisition process.

4.1 Interface Between the Office Responsible for the HSI Program and the Program Sponsor (PS). This interface is especially important since the PS and OHSIP are the major participants in initiating the HSI Program for each acquisition early in the Project Initiation Phase, well in advance of the PM being assigned.

a. Responsibilities for HSI.

(1) The PS supports the HSI Program by:

(a) Including HSI requirements, constraints, and criteria in major program documentation, such as Mission Need Statement (MNS), Preliminary Operational Requirements Document/Operational Requirements Document (PORD/ORD), and acquisition objectives.

(b) Requiring a review of the HSI Program during all system program reviews (e.g., prior to Key Decision Points).

(c) Funding and resourcing HSI Front-End Analysis (if required).

(2) OHSIP supports the HSI Program by conducting or coordinating all HSI activities in a materiel acquisition, including:

(a) Early Front End Analysis, development of Baseline Comparison System (BCS), Initial Estimate of Manpower (IEM), and TAD.

(b) Development of HSI objectives, constraints, performance criteria, trade-offs, risks, cost drivers, and requirements in all domains.

(c) Coordinating HSI input to all major program documentation, including:

1 Major System Acquisition Project Nomination Memorandum

2 MNS

3 Acquisition Plan (AP)

4 PORD/ORD

5 Project Management Plan (PMP)

6 TEMP

7 ILSP

8 Request for Proposals (RFPs)

(d) Development of all required plans related to HSI, including:

1 HSI System Management Plan

2 Human Engineering Program Plan (HEPP)

3 System Safety Program Plan (SSPP)

4 Health Hazard Program Plan (HHPP)

5 Equipment Facility Report (EPR) Plan

6 Training Evaluation Plan

7 Coast Guard Training Plan (CGTP)

(e) Conducting or coordinating all required HSI analyses, including:

1 Cost Benefit Analysis

2 HFE analyses to ensure effective and efficient man-machine interface

3 Analysis to determine System Safety/Health Hazards (SS/HH) issues

4 Manpower Analysis

5 Personnel Analysis

6 Training Analysis

7 BCS Analysis to determine IEM and other domain parameters

8 Test and Evaluation (T&E) Analysis to test for and correct system HSI problems in all domains

9 Trade-off Analyses

10 Life-Cycle Cost Estimate

b. Exchange of Necessary Information/Data/Documents/Etc. This category includes all types of shared information from one party in the interface to the next.

(1) Inputs from PS to OHSIP

(a) Mission requirements

(b) Technology assessment data

(c) Mission functional analysis data

(d) System requirements

(e) System cost/effectiveness analysis data

(f) Any MNS updates

(g) Any known HSI constraints, e.g., manpower or training limitations

(2) Inputs from OHSIP to PS

(a) IEM

(b) HSI inputs to MNS and PORD/ORD

(c) HSI inputs to acquisition objectives

(d) HSI Program update at system program reviews

c. Coordination/Communications Required to Properly Execute the HSI Program.

(1) OHSIP provides PS with a briefing on how the HSI Program works, coordination required, etc. as soon as possible after the Project Initiation Phase commences.

(2) OHSIP coordinates with PS to establish the HSIJWG and the HSISMP in the early stages of the Project Initiative Phase.

4.2 Interface Between OHSIP and the Project Manger. From time of assignment, the PM by charter has overall responsibility for planning, organizing, directing, and controlling the assigned acquisition project. OHSIP is responsible for conducting HSI domain processes and activities to provide HSI products and inputs to the PM in a timely manner to meet the approved acquisition schedule. Since the PM is not assigned until the Concepts Exploration Phase, OHSIP will have started and completed a significant amount of Front-End Analyses and HSI planning when the PM is assigned. One of the responsibilities of OHSIP, as soon as convenient after the PM reports, is to brief the new PM on all HSI activities underway, completed, and planned for the future.

The HSI Program will provide the acquisition process with domain experts who have not been available in the past and who will commence developing domain processes in the Project Initiation Phase, much earlier than they occurred in the past. A substantial amount of planning and analyses that the PM has previously been required to do should already be completed when the PM reports. The PM should arrive with a process well underway to influence system design in all five HSI domains, while systematically developing MPT requirements in a timely fashion. The HSI Program should reduce the PM's workload while greatly improving both systems design and the process of developing life-cycle support requirements.

a. <u>Responsibilities for HSI</u>.

(1) The PM supports the HSI Program by:

(a) Including HSI objectives, constraints, performance criteria, trade-offs, risks, cost drivers, and requirements in major program documentation, including PMP, AP, TEMP, and ILSP

(b) Including HSI status and issues as part of all program reviews

(c) Providing adequate funding for any remaining HSI Front-End Analyses. (Note: Since the PM is not assigned to the project until the Concepts Exploration Phase, the OHSIP should be separately funded (or appropriately manned with qualified analysts) to conduct required Front-End Analyses. These critical analyses must be mostly completed in the Project Initiation and Requirements Definition Phases to have any impact on system design.)

(d) Requiring MPT inputs for each design alternative; presenting the Coast Guard decision authority with the balance between acquisition and ownership costs for each design alternative

(e) Assisting the OHSIP where possible to ensure (1) that the HFE and SS/HH are included in the system design, and (2) that all HSI plans are properly executed, the results are included in applicable documentation,a nd all recommended HSI inputs are considered or made available to appropriate Coast Guard decision authorities

(f) Assisting the OHSIp where possible to ensure that all HSI domains are properly tested and that follow-up occurs to ensure al HSI criteria are met in the deployed system

(g) Including HSI requirements in the Circular of Requirements/RFP

(h) Using HSI as one of major source selection criteria

(2) The OHSIP supports the HSI Program by: Refer to OHSIP responsibilities under paragraph 4.1.a.(2).

b. Exchange of Necessary Information/Data/Documents/etc.

(1) Inputs from PM to OHSIP — There should be mutually agreed inputs determined on a case basis as a working relationship is established with each new PM.

(2) Inputs from OHSIP to PM

(a) Program guidance and constraints known to joint working group members that impact HSI domains

(b) Data from members with institutional data bases, such as manpower planning data, and personnel data describing characteristics for use in the TAD and the amount/kind of training currently received by ratings/pay grades of interest, etc.

(c) Review HSI plans, completed analyses, and other HSI documentation as requested

(2) Inputs from OHSIP to HSIJWG

(a) HSI inputs to major program documentation, including PMP, AP, TEMP, and ILSP

(b) HSI inputs for program reviews

(c) MPT inputs for each design alternative and Life-Cycle Cost Estimates

(d) HSI inputs as required for all domains, including inputs for trade-off analyses, risk assessments, feasibility studies, configuration management, testing, RFP development, and Operational Logistic Support Plans (OLSPs)

(e) HSI training as required for PM matrix organization

c. Coordination/Communications Required.

(1) As soon as convenient after the PM is assigned, OHSIP should brief the new PM on HSI activities in the first two phases, as well as planned follow-on activities, including:

(a) HSI constraints, objectives, criteria, and requirements.

(b) HSI inputs to Major System Acquisition Project Nomination Memorandum (i.e., IEM), acquisition objectives/strategy, and PORD/ORD

(c) The BCS chosen and information derived from it

(d) Any Front-End Analyses that remains to be completed

(e) Any plans or issues still being worked, including any requiring PM support or assistance

(2) There should be periodic discussions between the OHSIP and PM on the status of HSI issues/concerns of mutual interest.

4.3 Interface Between OHSIP and the Manpower Proponent in the Office of the Chief of Staff. G-CCS is responsible for management of current year and out year manpower requirements, and for approving all military/civilian billets/positions in the Coast Guard. In meeting these responsibilities, the Office of the Chief of Staff has developed manpower expertise and billet/position data that OHSIP needs to properly execute the HSI Program. G-CCS, for example, is the Coast Guard expert on the affordability of manpower and on the appropriate military/civilian manpower mix needed to meet the requirements of new acquisitions.

a. Responsibilities for HSI.

(1) The Manpower Proponent supports the HSI Program by:

(a) Providing an officer/enlisted/civilian Manpower Planning System for use in evaluating manpower affordability of the new system based on known or anticipated end-strength ceilings and other known manpower requirements in the years the new system is expected to be delivered

(b) Working with OHSIP to assess manpower affordability for the new acquisition

(c) Advising OHSIP on the number and quality of billets needed to support the General Detail Account for new acquisitions, based on the number and quality of billets required for the new system

(d) Providing assistance as necessary to meet the manpower requirements of the HSI Program

(2) OHSIP Supports the HSI Program By: Refer to OHSIP responsibilities under paragraph 4.1.a.(2).

b. Exchange of Necessary Information/Data/Documents/etc.

(1) Inputs from the Office of the Chief of Staff to OHSIP

(a) Data as required from Manpower Planning and Tracking Systems, plus any additional information that may be useful in system design

(b) Manpower expertise for advice on plans, concepts, analyses, testing, etc.

(c) Assistance in determining system manpower affordability and other manpower issues

(2) Inputs from OHSIP to the Office of the Chief of Staff—OHSIP will periodically discuss HSI manpower requirements with representatives of the Office of the Chief of Staff to determine if inputs are required.

c. Coordination/Communications Required. There should be periodic discussions between managers in the Office of the Chief of Staff and OHSIP on the status of HSI matters of mutual interest, and to provide feedback to both parties on how the HSI process is working.

(1) As soon as convenient after the PM is assigned, OHSIP should brief the new PM on HSI activities in the first two phases, as well as planned follow-on activities, including:

4.4 Interface Between OHSIP and the Manpower Proponent in the Office of Personnel and Training. The Office of Personnel and Training is responsible for all aspects of Coast Guard personnel management. In meeting these responsibilities for all aspects of Coast Guard personnel management. In meeting these responsibilities, the Office of P has developed personnel expertise and data that are required by OHSIP in executing the HSI Program in system acquisitions. For example, the Office of P is the Coast Guard expert on how many of what kinds of people the Coast Guard expects to have and to need in the future, and whether the personnel requirements of the new acquisition can be adequately supported in the timeframe required.

a. Responsibilities for HSI.

(1) The Manpower Proponent supports the HSI Program by:

(a) Providing an officer/enlisted/civilian Personnel Tracking System and other data bases for use in developing the TAD and determining the training provided to rating and skill specialties of interest

(b) Providing occupational standards relating specific skill levels to each enlisted rating and pay grades and providing similar information for civilian career fields/pay plans

(c) Working with OHSIP to assess manpower affordability and whether the personnel system is able to support the new system with the numbers of qualified and trained personnel needed and in the timeframe required

(2) OHSIP supports the HSI Program by: Refer to OHSIP responsibilities under paragraph 4.1.a.(2).

b. Exchange of Necessary Information/Data/Documents/etc.

(1) Inputs from the Office of P to OHSIP

(a) Data as required Personnel and Tracking Systems, plus any additional information that may be useful in system design

(b) Occupational standards as required

(c) Personnel expertise to advise on plans, concepts, analyses, testing, etc.

(d) Assistance in determining system personnel supportability

(2) Inputs from OHSIP to the Office of P — OHSIP will periodically discuss Personnel HSI requirements with Office of P representatives to determine if inputs are required.

c. Coordination/Communications Required. There should be periodic discussions between Managers in the Office of P and OHSIP on the status of HSI matters of mutual interest, and to provide feedback to both parties on how the HSI process is working.

4.5 Interface Between OHSIP and the Personnel Proponent in the Office of Personnel and Training. As the Coast Guard institutional representative for the training domain, the Office of P is the expert on Coast Guard training capabilities and limitations. The Office of P has both training expertise and training data on courses and training capacity that are required by OHSIP to adequately determine the training required and develop the Coast Guard Training Plan for new acquisitions.

a. Responsibilities for HSI.

(1) The Personnel Proponent supports the HSI Program by:

(a) Providing details on existing training courses and training facilities in the Coast Guard, including courses available from the Navy and other known sources

(b) Working with the OHSIP to develop the most cost effective and workable Coast Guard Training Plan

(2) OHSIP supports the HSI Program by: Refer to OHSIP responsibilities under paragraph 4.1.a.(2).

b. Exchange of Necessary Information/Data/Documents/Etc.

(1) Inputs from the Office of P to OHSIP

(a) Data as necessary on existing Coast Guard training courses and training facilities

(b) Training expertise for advice on plans, training concepts, analyses, testing, and the CGTP for the new system

(2) Inputs from OHSIP to Office of P — OHSIP will periodically discuss training requirements with the Office of P representatives to determine if inputs are required

c. Coordination/Communications Required. There should be periodic discussions between Training Managers in the Office of P and OHSIP on the status of training matters of mutual interest, and to provide feedback to both parties on how the HSI process is working.

4.6 Interface Between OHSIP and the SS/HH Proponent in the Office of Health and Safety. The Office of Health and Safety has delegated the authority to satisfy SS/HH domain requirements in system acquisitions to the Office of Acquisition. Even so, the Office of K has health and safety expertise and, perhaps, data that is useful to OHSIP in carrying out SS/HH

domain responsibilities in individual acquisitions. The Office of A should have useful records of past acquisitions, including SS/HH lesson learned.

a. Responsibilities for HSI.

(1) The SS/HH Proponent supports the HSI Program by:

(a) Providing SS/HH lesson learned and any other data support that could be applied to the design of new acquisitions

(b) Providing SS/HH expertise to help solve safety and health hazard issues in system design

(2) OHSIP supports the HSI Program by: Refer to OHSIP responsibilities under paragraph 4.1.a.(2).

b. Exchange of Necessary Information/Data/Documents/etc.

(1) Inputs from the Office of K to OHSIP

(a) Any available SS/HH data appropriate to system design

(b) Advise in developing SS/HH Plans and in problem solutions

(2) Inputs from OHSIP to the Office of K — OHSIP will periodically discuss SS/HH requirements with Office of K representatives and determine if inputs are required.

c. Coordination/Communications Required. There should be periodic discussions between safety and health hazard managers in the Office of K and OHSIP on the status of SS/HH matters of mutual interest, and to provide feedback to both parties on how the HSI process is working.

4.7 Interface Between OHSIP and the Human Factors Engineering Proponent. Human Factors Engineers are trained in human psychological, social, physical, and biological characteristics and limitations. This body of knowledge is applied to the design, operation, and use of materiel systems to optimize human performance, health, safety, and habitability.

In applying human factors during the design of a new acquisition, the engineer identifies all the interactions that humans require with machines in operating, maintaining, and otherwise supporting the new system. This is accomplished through functional allocation and the analysis of each human task to be performed. The HFE subsequently ensures that each man-machine-interface (MMI) is designed to maximize system performance. The Human Factors Engineering Domain makes the greatest contribution of all the domains to hardware, software, and procedural

design, specifically to ensure proper functioning of the equipment levels, etc.) that the Coast Guard anticipates having available to support the new system when fielded.

In carrying out these responsibilities, the HFE assigned to the OHSIP will need to interface periodically with other Coast Guard Human Factors specialist to exchange ideas and information pertinent to HFE in the Coast guard. In addition, the engineer will occasionally need other inputs and perspectives regarding specific human factors issues that arise during the acquisition process.

a. <u>Responsibilities for HSI</u>.

(1) The Human Factors Engineering Proponent supports the HSI Program by:

(a) Assisting as requested in the review of HFE plans, issues, analyses, and tests involved in individual Coast Guard acquisitions

(b) Providing data, studies, and other applicable HFE information, as requested

(2) OHSIP supports the HSI Program by: Refer to OHSIP responsibilities under paragraph 4.1.a.(2).

b. <u>Exchange of Necessary Information/Data/Documents/etc.</u>

(1) Inputs from the Human Factors Engineering Proponent to OHSIP — Any information, data, or advice that furthers OHSIP efforts to meet HFE requirements in the Coast Guard acquisition process

(2) Inputs from OHSIP to HFE Proponent

(a) Update on the status of individual acquisitions as mutually agreed

(b) Other inputs appropriate to keeping the HFE Proponent informed on areas of mutual interest

c. <u>Coordination/Communications Required</u>. There should be periodic discussions between OHSIP and the HFE Proponent on the status of HSI mattes of mutual interest, and to provide feedback to both parties on how the HSI process is working.

4.8 <u>Interface Between OHSIP and the ILS Manager</u>. While the ILS and HSI Programs both require access to some of the same data in executing their responsibilities, the objectives of the two programs are fundamentally different. ILS is chartered to determine and document supportability of acquisition systems; HSI's focus is on performance and operability in those

same systems. HSI has a more systems engineering orientation and an overriding concern for impacting system design. Rather than conflicting, ILS Manager will benefit from a substantial amount of research and analysis conducted by the OHSIP, including the IEM, TAD, and most (perhaps all) of the FEA.

The ILS Manager has traditionally been required to start developing the ILS Program requirements after reporting to the project near the middle of the Concepts Exploration Phase. With the HSI Program in place, the ILS Manager will benefit from a substantial amount of research and analysis conducted by the OHSIP, including the IEM, TAD, and most (perhaps all) of the FEA.

OHSIP will have performed the initial Front-End Analysis when the ILS Manager reports to the Project, and can start with that information as a hand-off from OHSIP. Many ILS tasks will complement the HSI analysis in such areas as design alternatives, while other tasks are almost completely maintenance related and are normally done entirely by the ILS Manager. Included are such items as supportability-related factors for repair parts cost, sparing methodology, and tools and test equipment that are not a part of the MAPTIDES Methodology.

The primary focus of the ILS Manager in system acquisitions is on spares, tools and test equipment, technical manuals, maintenance training materials, maintenance manpower, and training course development for maintainers. The OHSIP is also interested in providing HFE inputs to such areas as cautions/warnings in technical publications (where safety and health hazards information is required), as well as training material requirements, and what training courses are needed. With the proper interface, the ILS Manager should benefit from OHSIP's early analyses, and the requirements of both parties should be met without duplication of effort.

a. <u>Responsibilities for HSI</u>

(1) The ILS Manager supports the HSI Program by:

(a) Further refining and documenting maintenance manpower requirements

(b) Ensuring that HFE procedural development is included in system technical publications

(c) Ensuring that system safety and health hazard requirements are included in cautions and warnings at appropriate locations in operator and maintainer technical manuals

(d) Refining and documenting training material requirements

(2) The OHSIP supports the HSI Program by: Refer to OHSIP responsibilities under paragraph 4.1.a.(2).

b. <u>Exchange of Necessary Information/Data/Documents/etc.</u>

(1) Inputs from the ILS Manager to OHSIP

(a) Any additional information that changes the number of quality of maintenance manpower from OHSIP estimates

(b) Any additional information that changes the maintenance training materials from OHSIP estimates

(c) Information that causes any OHSIP MPT estimates to be reviewed or changed

(2) Inputs from OHSIP to ILS Manager

(a) Any HFE inputs that should be reflected in system operator or maintainer technical publications

(b) All MPT estimates at the time the ILS Manager is assigned

c. <u>Coordination/Communications Required.</u>

(1) OHSIP will brief the ILS Manger on all analyses and MPT estimates derived up to the time the ILS Manager is assigned and on planned activity in follow-on phases.

(2) Both the OHSIP and the ILS Manager should coordinate their activities and communicate their findings of interest to both parties throughout the acquisition phases.

(3) There should be periodic discussions between the ILS Manager and OHSIP on the status of MPT matters of mutual interest and to provide feedback to both parties on how the HSI process and the ILS program are dovetailing together.

# SECTION D
# HSI PROGRAM PROCESSES

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## LIST OF EXHIBITS

# SECTION D
# HSI PROGRAM PROCESSES

This section covers the more critical aspects of executing an effective HSI Program. The section begins with a discussion of the data and data bases the OHSIP needs to influence system design and determine MPT requirements. Next is a description of the Front-End Analysis and a discussion of the critical nature of this early analysis on the HSI Program's ability to influence system design. That is followed by a description of Request for Proposal (RFP) requirements and a discussion of cost determination in the HSI Program. The section culminates with a description of the specific domain processes recommended for the Coast Guard HSI Program.

1. <u>DATA AND DATA BASES REQUIRED</u>. Success of the HSI Program depends on the OHSIP's ability to identify information needed, collect and develop that information, and use the results to influence the system design. This paragraph will discuss the five primary categories of information and the two types of data systems required.

a. Categories of HSI Information — The following five main categories of HSI information are discussed including data sources.

(1) Deficiency Information/Performance Requirements — What people tasks are difficult to train or perform? What man-machine interface problems have been identified in predecessor or similar systems?

(a) Sources of this type of information include Operational Requirements Documents (assuming the requirements system is concepts-based).

(b) Types of information available include those that:

<u>1</u> Identify deficiencies

<u>2</u> Identify overall performance requirements

<u>3</u> Promulgate objectives

(2) Program Guidance — What decisions have been made that impact system design (capabilities) or impose constraints or limitations on available resources (e.g., manpower, personnel, training base, or funding resources)? Sources of this type of information include the following:

(a) Coast Guard/Department of Transportation (DoT) Program Guidance including Coast Guard resource constraints on training time, dollars, personnel, and manpower.

(b) The Office of Acquisition also promulgates guidance that falls into this category.

(3) Lessons Learned — What are the human performance deficiencies of the current system? What residual hazards have not been eliminated from the current or similar systems? Sources of this type of information include the following:

(a) Lessons-learned data bases in each domain, including:

1 Safety lessons

2 Logistics lessons, including MPT

3 Health lessons

4 High drivers

5 Human Factors Engineering lessons

(b) Records of previous acquisitions are a primary source of this category of information.

(4) Prediction — Have the abilities and limitations of future Coast Guard personnel been considered when computing the total system performance requirements of the new system? Have all the ownership costs been included when computing total life-cycle cost of the system? Sources of this type of information include:

(a) Target Audience Description (TAD)

(b) Front-End Analyses

(c) Other Predictions of Future Limitations and Constraints

(5) HSI Assessment — What unresolved HSI issues need to be addressed? What is the status of key source documents and analyses? Sources of this type of information include assessments done prior to each Key Decision Point to resolve:

(a) Unresolved Issues

(b) Status of Key Analyses

b. Data System Requirements — Two types of data systems are required to support the HSI Program in the acquisition process: A data system to track and document issues, analyses, actions taken, and lessons learned in each domain for each acquisition project (i.e., this is one data system with a module for each domain); and institutional data systems maintained by and for the primary use of organizations responsible for that functional area.

(1) The following institutional data systems are needed:

(a) Manpower Planning System — This system projects manpower (billet) requirements for each year over the next 5 years (minimum).

1 The system should include three billet modules: officer, enlisted, and civilian. Officer and enlisted modules should include both active duty and reserves.

2 The military billets/civilian positions in each module should include: billet/position title, occupational specialty, pay grade, and special skill requirements.

3 The Manpower Planning System will be used by the acquisition process to answer questions such as the following: Is the Coast Guard manpower required for this new system affordable? Does the Coast Guard expect to have the appropriate occupational specialties required for this system or must a new rating be developed?

(b) Personnel Planning System — This system projects personnel expected to be in the Coast Guard for each year over the next 5 years (minimum). The Target Audience Description is partially derived from the Personnel Planning System.

1 This system should include three modules: officers, enlisted, and civilian. Officer and enlisted modules should include both active duty and reserves.

2 Officer and enlisted modules should include the personnel expected in the Coast Guard each year. Each individual should have a military occupation, pay grade, special skills identifiers, training received, Armed Forces Qualification Test (AFQT) or other mental group scores, and Armed Services Vocational Aptitude Battery (ASVAB) or other aptitude scores.

3 This system will be used to answer such questions as: What range of aptitude scores are appropriate for personnel in the new system? What occupational specialty is most appropriate for the new acquisition?

(c) Training Data System — This data system provides existing training course information, including Coast Guard and applicable Navy schools, home study, and other courses available to the Coast Guard.

1 The system should provide the following information: Description of each course, length, location, and entrance criteria (e.g., AFQT scores, experience, and occupational specialty).

2 Data from this system will answer questions such as: Does the Coast Guard have a training course already available to support this new system or must a new course be developed?

(d) Human Factors Engineering Data System — This data system should provide information that enables the identification of system elements to be targeted for Human Factors Engineering during the system development cycle.

1 The system should provide the following information: Historical human factors data that consists of design solutions that were addressed and ameliorated by HFE in previous design and similar acquisition efforts.

2 Data from this system should answer questions such as: Has the Coast Guard experienced problems in similar equipment in the past that can be solved by proper HFE design of the new system? Are there particular HFE techniques that have worked better for equipment such as that included in the new acquisition?

(e) System Safety/Health Hazards Data System — This data system provides historical safety data that includes lessons learned from previous design and similar acquisition efforts.

1 The system should provide the following information: Design solutions that were addressed and ameliorated by System Safety Engineering in previous design and similar

acquisition efforts. The system also should classify hazards encountered and ameliorated during previous system design, operation, and support.

2 Data from this system should answer questions similar to the following: Has the Coast Guard experienced problems in similar equipment in the past that can be solved by incorporation of SS/HH considerations into the design of the new system? Are there particular SS/HH procedures or techniques that have worked best for Coast Guard in the past and, therefore, should be considered in the new acquisition?

(2) A data system is needed to track individual acquisition projects.

(a) This requires a data system with modules for each of the HSI domains, an HSI Program module for the HSI System Management Plan (HSISMP), and other documentation not related to a single domain.

1 This system tracks the various iterative processes encountered during a system acquisition.

2 The result is retained as a historical record for use as a Baseline Comparison System and lessons learned in future acquisitions.

(b) The following modules are required by the domains indicated. Recorded data developed by each domain is required as inputs to program documentation in each acquisition phase.

1 Human Factors Engineering Data Base — Records all HFE plans, analyses, assessments, interface problems and solutions, lessons learned, and other HFE activities as necessary.

2 System Safety/Health Hazards (SS/HH) Data Base — Records all SS/HH activity including plans, analyses, assessments, problem areas and solutions, lessons learned, etc.

3 Manpower Data Base — Includes data from the Manpower Planning System applicable to this acquisition, manpower plans, analysis, Initial Estimate of Manpower,

Manpower/Personnel and Training Integration in the Design of Systems (MAPTIDES) Methodology applicable to each phase of this acquisition (described later in this section), final estimates of manpower, lessons learned, and other manpower data as required.

4 Personnel Data Base — Includes data from the Personnel Planning System applicable to this acquisition, personnel plans, analysis, skill level, mental group trade-offs, final determination of supportability, lessons learned, and other personnel data as necessary.

5 Training Data Base — Records training plans, analysis, trade-offs, training inputs for each design alternative, training costs for total life-cycle cost estimates, lessons learned, and other training data as required.

6 HSI Program Data Base — Includes all HSI plans, issues, activities, and documentation not directly related to developing individual domain inputs. The following are examples of this type of data:

a HSISMP and updates

b Program document inputs are normally collected from all domains and consolidated into one HSI input

c Hardware/software contractor inputs to RFPs

d Life-cycle cost estimates

2. FRONT-END ANALYSIS (FEA). The FEA is the most critical step required to develop the information needed for HSI to influence system design in an individual acquisition. The FEA determines HSI constraints, performance criteria, objectives, trade-offs, risks, cost drivers, and other inputs required for program documentation, and it also includes strategy and criteria for integrating HSI into design specifications. Without this critical information on the front-end of the process when program documents are being developed, HSI cannot influence system design.

a. Mission and Support System Definition tasks form the nucleus of FEA (other analyses may be required by OHSIP). The tasks include the following:

(1) Task 1. Use Study — Identifies and documents pertinent supportability factors of the proposed system, including the following:

  (a) Deployment scenarios

  (b) Mission frequency and duration

  (c) Service life

  (d) Operational environment

(2) Task 2. Mission Hardware, Software, and Support System Standardization — This task defines design constraints of the proposed system based upon existing and planned logistic support resources (i.e., use as much existing support as possible before acquiring something new). It also provides supportability input to mission hardware and software standardization efforts.

  (a) The results of this task are used as inputs to Tasks 1 and 4.

  (b) It also includes supportability constraints, supportability characteristics, recommended approaches, and risks (e.g., risks in terms of cost, personnel, and technical risk) for each HSI domain.

(3) Task 3. Comparative Analysis — Develops a Baseline Comparison System (BCS) representing the characteristics of the proposed equipment for:

  (a) Projecting supportability-related factors and identifying targets for improvement. This is based on lessons learned in all HSI domains from previous systems.

  (b) Determining supportability, cost, and readiness drivers for the proposed system.

  (c) Documenting risks associated with using comparative data.

  (d) Developing supportability factors to be incorporated into operational requirements and as input to Tasks 4 and 5.

  (e) Determining Initial Estimate of Manpower (IEM) and refinements in later phases.

(4) Task 4. Technological Opportunities — Identifies technological advancements and state-of-the-art design approaches that offer opportunities for achieving improvements in the new system.

(a) Qualitative support characteristics of alternative design and operational concepts (e.g., modular replacements for organizational-level maintenance concept).

(b) Support and support-related design objectives, goals and thresholds.

(c) Constraints for inclusion in requirements, decisions, program documents, and specifications.

(5) Task 5. Supportability and Supportability - Related Design Factors — This task is designed to establish:

(a) Quantitative support characteristics of alternative design and operational concepts.

(b) Support and support - related design objectives, goals, thresholds, and constraints for inclusion in requirements, decisions, and program documents including specifications.

3. <u>HSI IN REQUESTS FOR PROPOSALS</u>. In addition to completing the Front-End Analysis to determine HSI objectives, constraints, performance criteria, etc., and ensuring that this information is included in the major program documentation, two other actions are most critical in order for HSI to successfully influence system design: (a) HSI requirements must be included in the hardware/software contractor RFPs, and (b) HSI must be a substantial factor in RFP source selections.

The RFP is the principal means by which the Coast Guard communicates its materiel requirements to industry. There are at least two different categories of RFPs that are used in the acquisition process:

a. RFPs for system hardware/software designers and developers — HSI criteria and requirements must be included in these RFPs if HSI is to impact system design. This is the category of RFP that will be discussed in this document.

b. RFPs for support analyses — If the Coast Guard staffs the OHSIP to perform the HSI analyses in-house, this type of RFP should seldom, if ever, be required.

3.1 Hardware/Software Contractor Solicitation Process. The solicitation process is an extension of the requirements process, incorporating both the Program Sponsor's performance requirements and the Office of Acquisition program requirements. The solicitation process is illustrated in Exhibit D-1 and can be viewed as the interrelated functions of solicitation,

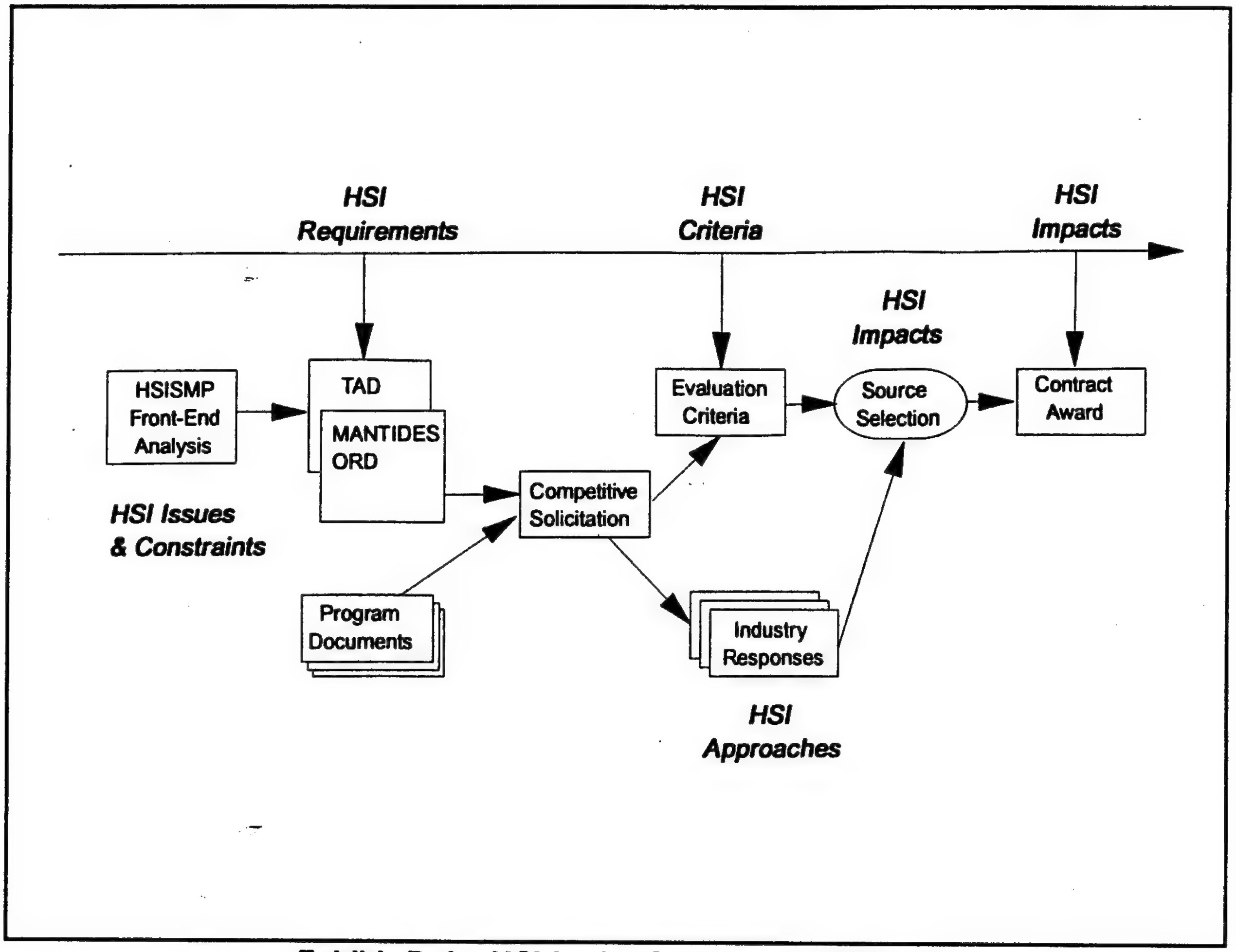



**Exhibit D-1. HSI in the Solicitation Process**

source selection, and contract award. The inclusion of HSI in requirements, program, and decision documents is meaningless unless this same integration process occurs in solicitation documents. The objective is to send a signal to industry that the Coast Guard is serious about HSI and that inclusion of human performance considerations into their system design, development, and production proposals is the only way contractors can successfully bid Coast Guard acquisition RFPs.

a. The OHSIP leads the process of preparing HSI inputs to hardware/software design, development, and production RFPs, assisted by the Program Sponsor and supported by other specialists as required. Procedures for writing and processing

RFPs are well established in the laws, regulations, and policies governing materiel acquisition. The challenge is to take the technological requirements arising from an operational need and convert them into relevant acquisition language that is understood and can be responded to by industry.

b. HSI requirements are refined into contractual language and included in a solicitation document such as an RFP. For convenience, we have referred to the period of transition from requirements document to RFP as the definition process. See Exhibit D-2 below.

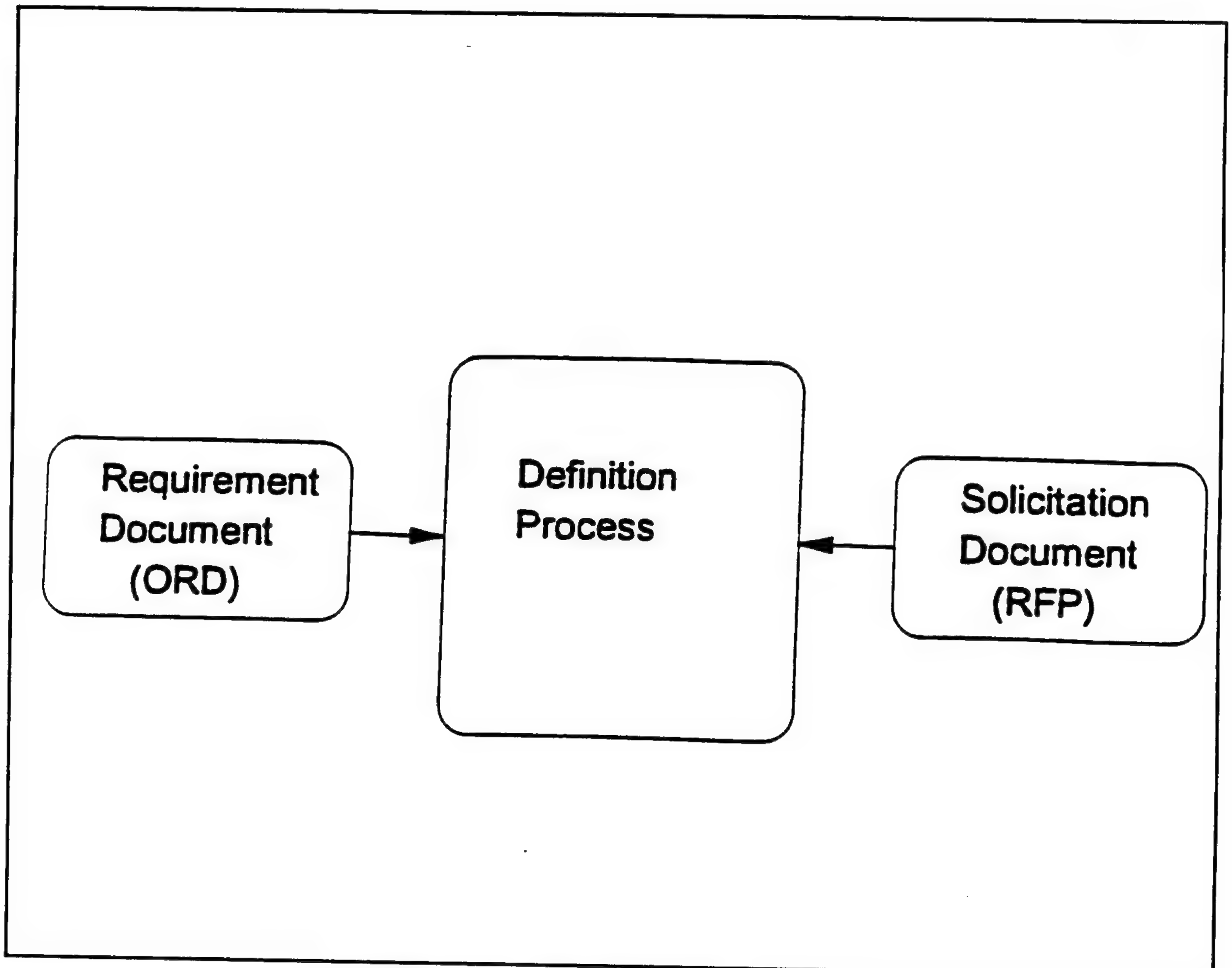



**Exhibit D-2. The Definition Process**

c. During the life cycle of a single materiel system, RFPs may be written in several acquisition phases. There are qualitative differences in the way HSI affects the RFP in each phase. If HSI is to contribute to effective system design, its influence must be felt during the earliest acquisition phases. Key design questions (for example, the choice of crew size, and thus the basic architecture of a system)

are decided early and should have HSI data for consideration from all HSI domains.

d. The following five rules of thumb are recommended to guide the RFP writer in developing the HSI portion of any RFP. Violation of any of these rules of thumb invites deficiencies in the ultimate effectiveness and availability of the fielded system.

(1) Rule of Thumb #1 — Human performance affects system performance. One important part of HSI in the RFP is to influence materiel design so that technology, and not the human, becomes the limiting factor in achieving desired system effectiveness.

(2) Rule of Thumb #2 — Skill is a function of aptitude and training. Aptitude consists of basic abilities inherent in the individual and not readily modified by training.

(a) Training refers to a series of activities, such as verbal instructions and practice on the job, which enables personnel to acquire skill in performing tasks that must be performed to accomplish Coast Guard missions.

(b) Training is most effectively evaluated in two dimensions:

1 Completeness — Covered everything the individual needed to know.

2 Sufficiency — Enough instruction and practice for the individual to achieve acceptable standards of performance.

(c) Traits that make up the quality called aptitude are stable over time.

(d) Skill is unstable over time due to proficiency decay as a function of time without practice. Proficiency of individuals with known aptitudes and training can be measured at a specific point in the training cycle, and those time and accuracy scores can be used to predict the level of performance in other individuals with known aptitudes, training, and practice.

(3) Rule of Thumb #3 — Measure individual performance by time and accuracy. This rule recognizes that human performance occurs simultaneously in two dimensions: time and accuracy.

(a) Measuring one without the other, or measuring them both but independently, will almost certainly produce a distorted picture of reality.

(b) This rule of thumb is vital in developing any data collection plan.

(c) System design defects that might have been disclosed early can be masked if, for example, performance data describes only the time to perform a particular task, rather than both time and accuracy.

(d) Operational Requirements Documents should state human performance standards in terms of both time and accuracy. These requirements should be faithfully translated into procurement and testing documents.

(4) Rule of Thumb #4 — Equipment design determines personnel tasks. This rule of thumb recognizes that the equipment designer has the power both to create and to eliminate human performance tasks.

(a) A system may involve very simple equipment and software attended by numerous and highly skilled operators, or the system may use highly automated equipment with few operators of much less skill.

(b) Tasks assigned by the designer to the human must be within the capabilities of Coast Guard personnel. This is the purpose of providing the Target Audience Description to the designer early in the process.

(5) Rule of Thumb #5 — Make the designer responsible for human performance. This rule tracks from rule #4 because the contractor's designer determines the human tasks for operators and maintainers of any system. Since the designer has the power, he should have the responsibility and be accountable for exercising that power in a way that is consistent with capabilities and limitations of Coast Guard personnel.

e. Translating sponsor requirements into RFP language — If any one of the following four requirements is missing from the ORD, it must be created and included at the appropriate location in the RFP.

(1) Performance requirements expressed in objective, quantitative terms

(2) Maximum tolerable training burden (in terms of time and cost)

(3) Likely aptitudes of system operators, maintainers, and support personnel

(4) Directed limitations on manpower (e.g., crew size shall be no more than three) or organizational constraints

(5) Safety and Health Hazards

f. Exhibit D-3 depicts how HSI requirements drive the system design.

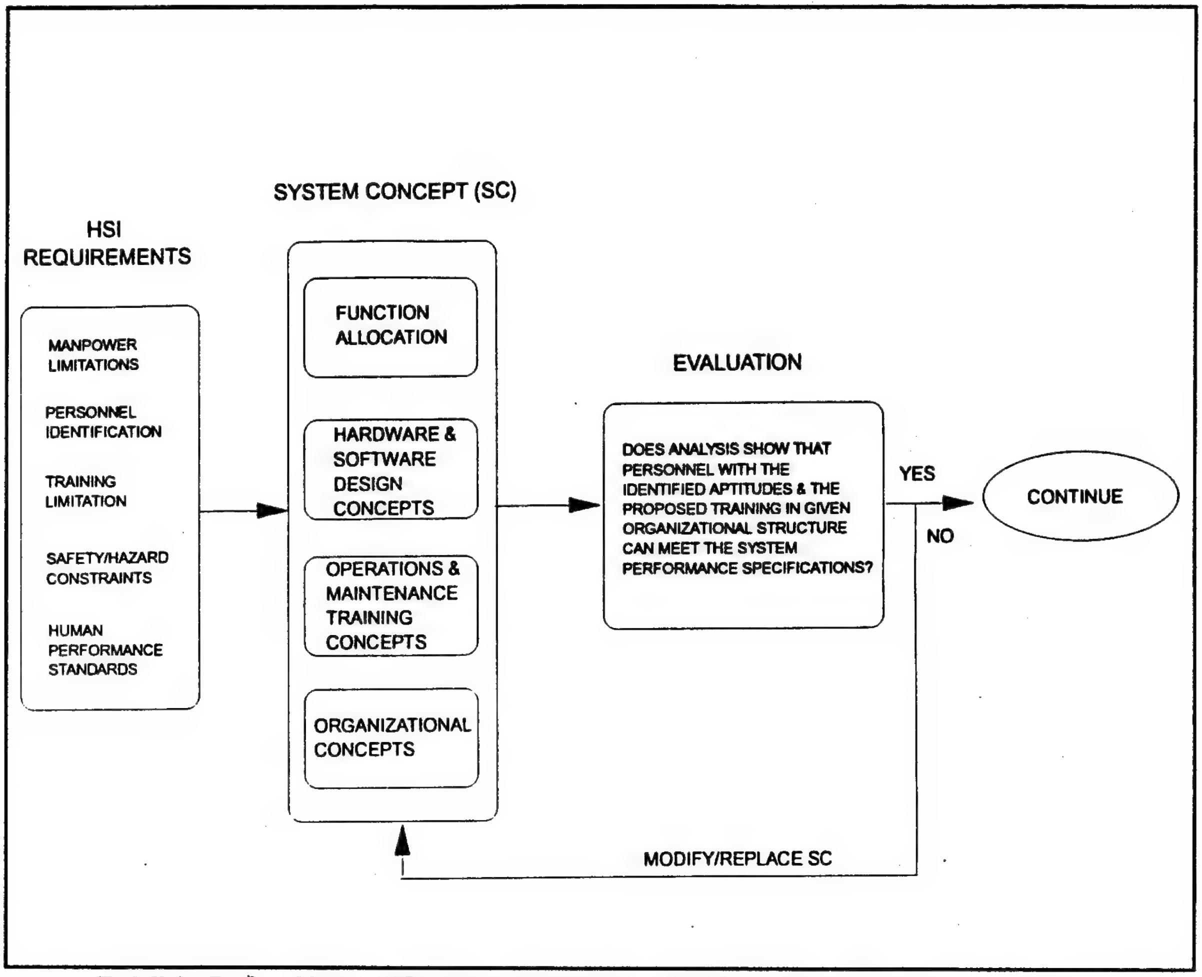



**Exhibit D-3. How HSI Requirements Affect Initial Design Concepts**

(1) Note that the four basic HSI requirements make direct inputs to development of the various system concepts that form the foundation for system design.

(2) Each system concept is then evaluated to determine if the human structure defined in the Target Audience Description can meet the system performance specification.

(a) If the answer is yes, the design can continue.

(b) If the answer is no, then the system concepts must be modified or replaced.

g. Personnel performance standards in the requirements above are used by RFP drafters to set parameters for trade-off analyses to be performed by contractors. See Exhibit D-4 for a trade-off example.

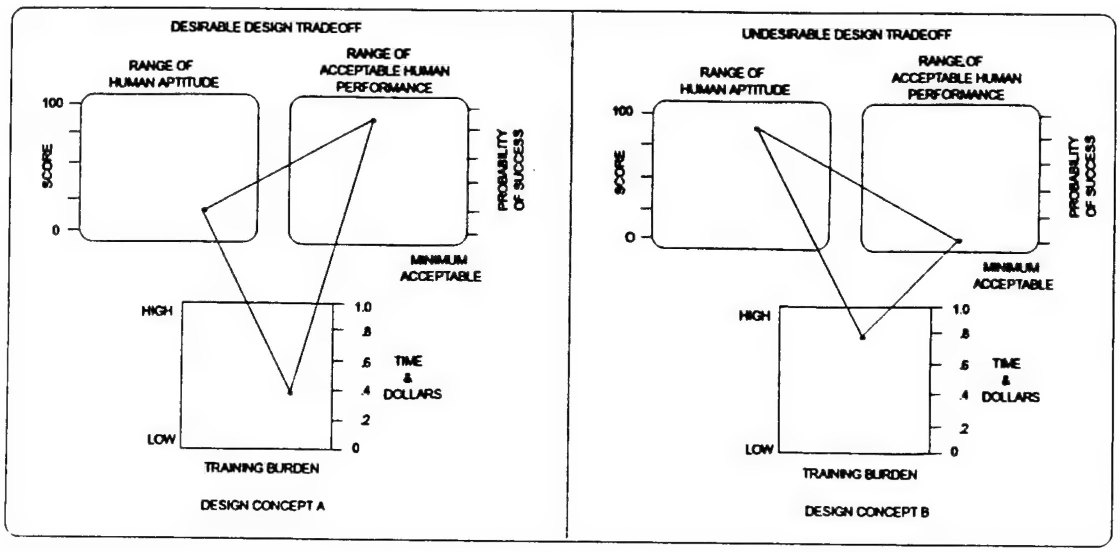



**Exhibit D-4. Example of Aptitude, Training, and Human Performance Trade-Offs**

(1) Note that design concept A in Exhibit D-4 is a desirable design trade-off because the system produces high performance with low personnel aptitude and a low training burden.

(2) Design concept B is an undesirable design trade-off because the system produces low performance, while requiring high personnel aptitude and a high training burden.

h. It is important to the success of the HSI Program that the Project Manager coordinate the hardware/software contractor RFPs with the office responsible for the HSI Program, Program Sponsor, and ILS Manager. Coordination should occur before technical requirements are submitted to the contracting officer.

i. HSI in the RFP structure — There are at least six places in the RFP format where HSI matters should be included.

(1) Executive Summary — Explains to senior industry personnel the major emphasis in the procurement, and should make clear the role of HSI in source selection.

(2) Statement of Work — States what the Coast Guard wants the contractor to do (i.e., task statements), and describes deliverables to be procured, as well as work to be done to ensure that the system performs as specified.

(3) System Specification — Describes how system hardware and software is supposed to appear and perform, and how appearance and performance are to be verified.

(4) Contract Data Requirements List (CDRL) — Explains what information (often reports) the contractor will be required to furnish, how often, and in what form.

(5) Instructions to Offerors (Section L) — Helpful hints to help offerors write more responsive proposals.

(a) May include coordination statements (e.g., that the HSI and ILS programs should not be conducted in duplicative fashion).

(b) Should also include instructions on what specific matters must be covered in the technical proposal. Since HSI is an integration effort, offerors will be instructed to address HSI as a separate major area and in every applicable portion of their proposals.

(6) Proposal Evaluation Criteria (Section M) — Explains how an offeror's technical proposal will be evaluated by the Source Selection Evaluation Board (SSEB), and will include both technical criteria and relative importance of HSI compared to the other separate major areas.

j. The RFP writer should prepare specific HSI requirements for each of the six elements of the RFP above. HSI requirements should be well balanced between each element.

(1) The impact of HSI requirements is enhanced by linking them to the proposal award evaluation factors. This is done in Section L (Instructions and Conditions and Notices to Offerors) and in Section M (Evaluation and Award Factors).

(2) Emphasis on HSI in Sections L and M reflects the degree of importance that the Coast Guard attaches to HSI. This emphasis can also be summarized and conveyed to industry in the Executive Summary.

3.2 <u>HSI in Source Selection</u>. We recommend that HSI be treated as a separate major area in source selections with the same visibility as technical, management, and cost, and that HSI be evaluated throughout all aspects of design, development, integrated logistic support, and program management. Using this basic philosophy, treatment of HSI should be tailored to suit the nature and priorities of the program and contract effort. An acceptable method of criteria weighing is shown in Exhibit D-5 below. Because HSI is evaluated separately and throughout, evaluators are cautioned to avoid double counting.

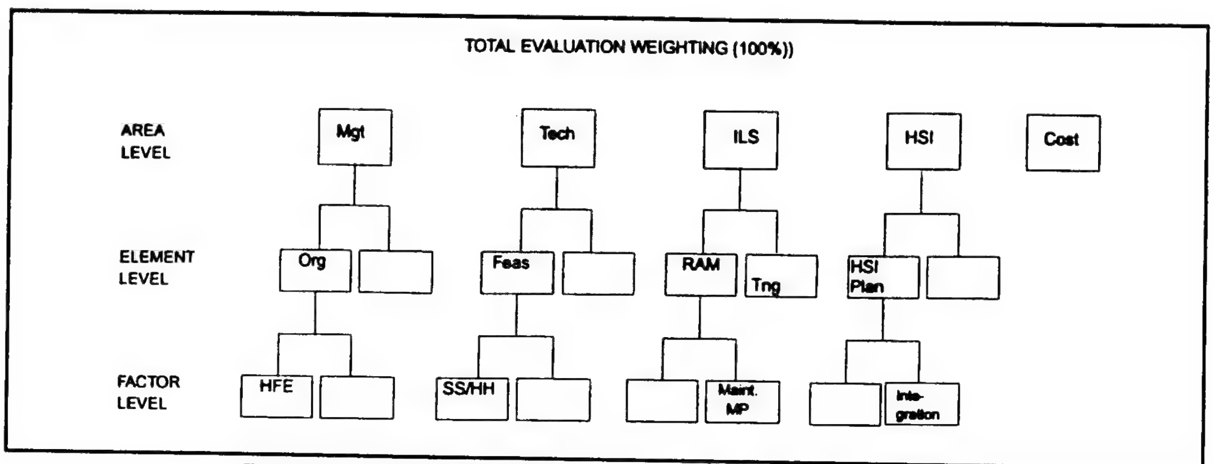



**Exhibit D-5. HSI in Source Selection Evaluation**

a. Procedures in the Solicitation

(1) The Statement of Work and the specifications should contain appropriate HSI requirements. In particular, the specification should describe how the system is to look and act to the user and how the requirements will be verified.

(2) Offerors should be instructed by the solicitation to address HSI in every applicable portion of their offers and as a separate major area.

(3) Offerors should be informed in the evaluation and award factors section of the overall importance of HSI evaluation relative to other separate major areas.

(4) All RFPs should contain a requirement for a contractor HSI Management Plan to be provided as part of the contractor proposal.

b. Structure of the Source Selection Evaluation Board (SSEB)

(1) The SSEB should be structured to establish and maintain HSI considerations as a visible part of the process. HSI should be considered across all major evaluation areas, as both a major area and as an integrating effort. Exhibit D-6 is an example demonstrating how properly weighted HSI considerations can impact the "best value" approach to selection of competing systems.

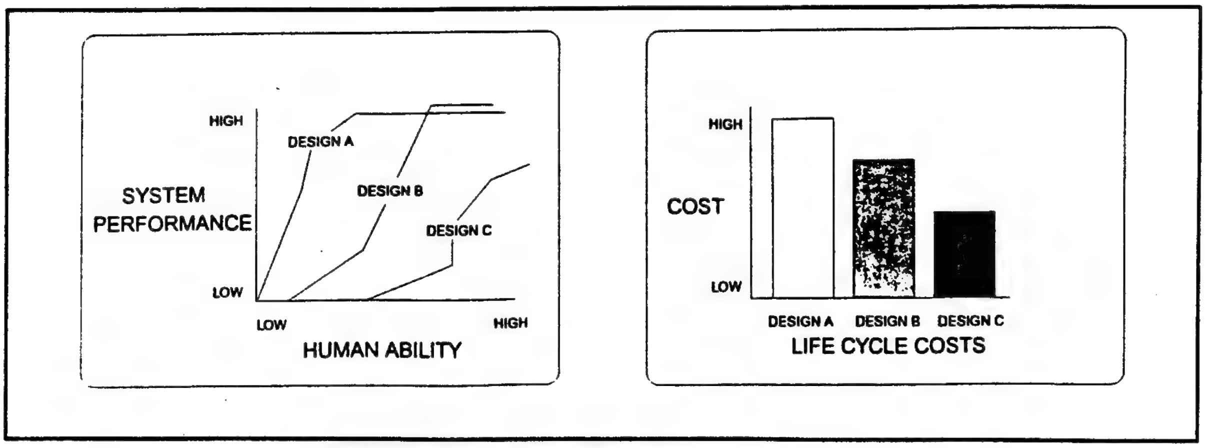


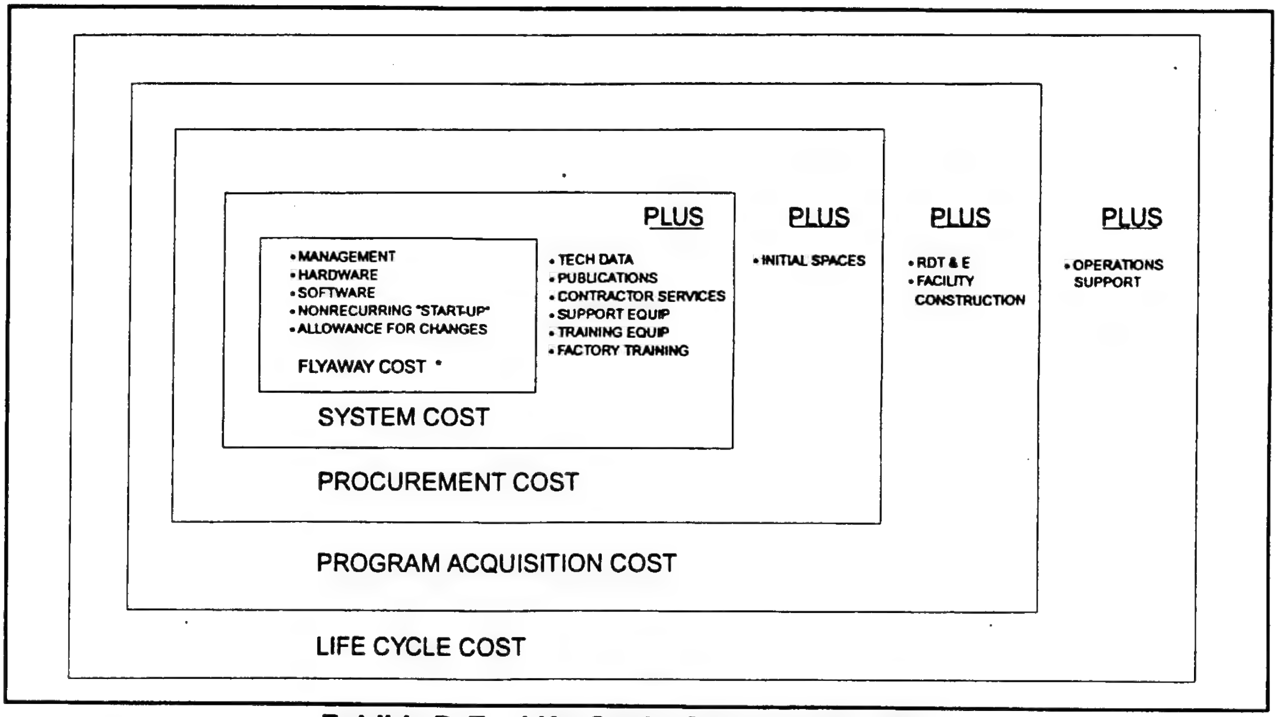

**Exhibit D-6. The Best Value Approach**

4. <u>COST DETERMINATION</u>. Exhibit D-7 displays total system life-cycle cost (LCC) to include the program acquisition costs to build the system, plus the ownership costs of operating and maintaining the fielded system.

a. LCC includes the cost of designing and developing both hardware and software, production of the new equipment, and logistics support for the life of the system, including primarily personnel and maintenance support training. These costs are cumulative through development, acquisition, operation, support and, where applicable, disposal.

b. Note from the graphic that LCC includes flyaway/rollaway/sailaway costs, plus system procurement, program acquisition, as well as operating and support costs.

c. Operations support (i.e., ownership costs) includes all types of support required to operate/maintain the system over its life cycle from time of fielding to disposal. Ownership costs vary significantly, may exceed acquisition costs, and include the following:




*Also called rollaway and sailaway cost

**Exhibit D-7. Life-Cycle Cost Composition**

(1) Personnel to operate and maintain the system, including all required maintenance levels (i.e., organizational , intermediate, and depot-level maintenance) — Also includes personnel retirement and health care costs

(2) Training for all operators and maintainers at all maintenance levels

(3) Replenishment parts for the system

(4) Costs to house the system and all levels of maintenance support (e.g., dedicated and shared test equipment and maintenance facilities)

(5) Cost to dispose of the system when its useful life is expended

4.1. <u>Determining Ownership Costs</u>. Personnel and training costs make up the major ownership costs once the system is fielded.

a. It is critical to include ownership costs in evaluating and selecting the most cost effective design alternative. This requires ownership costs to be determined for each design alternative as part of the Front-End Analysis. Providing this level of detail requires adequate analyst/contract funding support for early Front-End Analysis.

b. Failure to develop accurate ownership costs in making system design concept decisions results in selecting a design approach without adequate consideration of full life-cycle cost and is a very costly way of doing business.

c. Best Value Approach to Cost Determination — Exhibit D-6 demonstrates a method of comparing system performance to life-cycle costs for three design alternatives to arrive at the alternative that represents the best value to the Coast Guard between the three designs.

(1) Note that Design A produces one of the highest system performance levels with the lowest human ability requirements, but is the most costly.

(2) Design C is the least costly, but produces the lowest system performance and the highest human ability, while Design B falls between Designs A and C.

(3) Considerations in determining best value to the Coast Guard include the following:

(a) To be acceptable design alternatives, all three designs should meet the minimum required system performance level. So the issues in the least expensive alternative, Design C, are: Is the human ability level in Design C achievable? If the human ability level in Design C cannot be completely met, is the resulting degradation of system performance acceptable?

(b) Design B falls in the mid-range of human ability, which is presumably achievable without undue stress on the personnel system. The question then becomes: Is the increased system performance worth the additional cost over design C?

(c) In Design A, is either the low human ability level or the high system performance worth the added cost over Designs B and C?

5. HSI DOMAIN PROCESSES. In recent years, a number of world class disasters have occurred, including the nuclear power incident at Three Mile Island, the meltdown at Chernobyl, the downing of KAL-007 by the Soviets and of the Iranian Airbus by the U.S.S. Vincennes, and the inadvertent poison gas release at Bhopal. These catastrophes all had in common the fundamental problem that their high technology systems had been designed with greater emphasis on the equipment than the user. These and other tragic accidents have been attributed to people and organizations unable to adequately interpret and control technology. As technology advances and systems become more costly and complex, the importance and complexity of human/machine interaction increases. Nowhere is this more evident or more critical than with the high-risk technologies used by military services such as the Coast Guard.

During the 1980's, the DoD Military Services recognized the increase in technology as a growing problem that required distinctly new approaches to ensure human system integration in their acquisition processes. After nearly a decade of development, HSI emerged to address five distinctly different aspects or domains of human integration in system acquisitions. The HSI Program is a comprehensive management and technical initiative intended to enhance total system performance by integrating human performance, reliability, and survivability during system and equipment design, development, and modification. The goal of HSI is to successfully integrate technology and people to meet mission objectives under numerous environmental conditions at the lowest possible life-cycle cost. HSI promotes an increased emphasis on front-end planning to control the impact of the new system on the human by requiring consideration of issues related to five domains: Human Factors Engineering, System Safety/Health Hazards, Manpower, Personnel, and Training.

The following paragraphs will describe the essential elements of each domain. Commencing with paragraph 5.2, the processes needed to adequately address each domain in each acquisition will be described.

a. **Human Factors Engineering** is the application of information derived from human factors theory and modeling for the specification, design, development, testing, analysis, and evaluation of products or systems for human use. Human factors is the body of scientific knowledge concerned with human capabilities and limitations. Human factors includes principles and applications of human engineering, personnel selection, training, life-support, job performance aids, and human performance evaluation.

   HFE is the comprehensive integration of design criteria, physiological characteristics, psychological principles, and human capabilities into system design, development, test, and evaluation. The objective of HFE is to optimize performance of the human-machine combination. This is achieved by maximizing the ability of the operator/maintainer to perform at required levels by eliminating design-induced error.

   HFE considers all human sensory capability and limitations in system design, including identification of human sensory stimuli, information processing, and reaction or response to the stimulus. In the design of methods for presentation of information (e.g., displays and controls) to Coast Guardsmen, the HFE applies knowledge of the various human sensory mechanisms, including their relative capabilities and limitations, to optimize the proposed human-machine interface. This interface can be envisioned as an imaginary surface across which information and energy are exchanged between the human and machine components of a system. This domain is also concerned with the cognitive processes and aptitudes of operators and maintainers to evaluate acceptable workload levels, particularly under stressful conditions such as those found in rescue, law enforcement, or combat situations.

b. **System Safety** refers to the system's ability to be operated and maintained without accidental injury to personnel or damage to the system. System Safety involves the application of engineering, education, and management principles and techniques to design and develop a system that optimizes safety within the established operational, cost, and time parameters. Safety data is collected through lessons learned on predecessor systems and mishap data, as well as through the use of design trade-off data. A summary of the collected data provides a risk assessment, a potential hazard classification for the item, and a list of recommended procedures or other corrective actions to reduce these hazards to an acceptable level.

**Health Hazards** involves the identification and elimination of biomedical hazards associated with the system. A health hazard is defined as an existing or likely condition, inherent in the operation or use of materiel, that can cause death, injury, acute or chronic illness, disability, and/or reduced job performance. These conditions can result from either long-term or short-term exposure to shock, recoil, vibration, noise, toxic agents, radiation, heat and cold, and/or pathogenic microorganisms. Similar to System Safety, the Health Hazards portion of this domain seeks to improve total system performance while controlling health risks to the personnel who test, use, or service Coast Guard systems.

c. **Manpower** addresses the affordability of fielding a new materiel system in terms of the Coast Guard's human resources (i.e., all military billets and civilian positions). Affordability is determined by analyzing the applicable number and quality of billets/positions expected to be authorized throughout the Coast Guard at the time the new acquisition is fielded, including the manpower required by the new system. Consideration of the net effect of the new materiel system on overall Coast Guard human resource requirements and authorizations is critical to ensure the affordability of a proposed system. This consideration includes an analysis of the number and capabilities of people needed to operate, maintain, and support the proposed system (based on predecessor or similar system data); a determination of changes generated by the introduction of the system into the inventory; and an assessment of the impact these changes will have on the Coast Guard's manpower limits across all operational and maintenance levels affected by the system.

d. **Personnel** refers to the aptitudes, abilities, and other human characteristics of military billets and civilian positions. These are the attributes necessary to operate, maintain, and support a new materiel system and achieve optimal system performance in peace and wartime. Detailed analyses of personnel requirements for predecessor systems, based on system components, are necessary to project personnel requirements for the new system. The new system is designed based on the personnel projected to be available throughout the life cycle of the system.

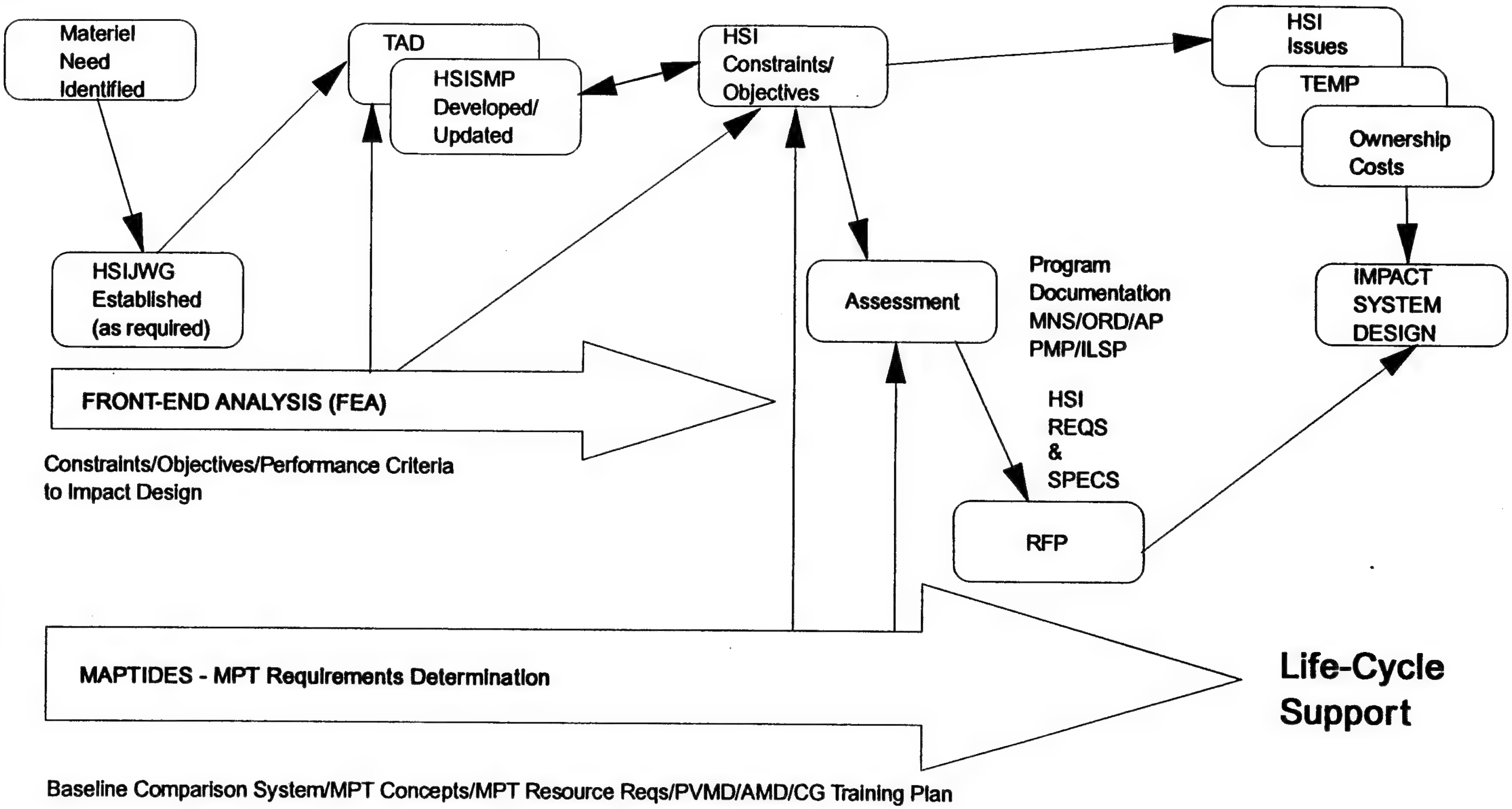
Personnel analysis data must be included in the system life-cycle cost estimates and are needed in time to allow for appropriate recruitment, training, and assignment of personnel in conjunction with system fielding.

e. **Training** refers to the requisite knowledge, skills, and abilities (KSAs) required by the available personnel to operate and maintain systems under peace and wartime conditions. Training considers the time and cost to provide necessary skills and knowledge through entry-level and sustainment training to qualify Coast Guard personnel for support of the new system. Consideration of training needs requires the formulation and selection of engineering design alternatives that are supportable from a training perspective. It also includes the identification of resource requirements, the formulation of training strategies, the availability of training resources (to include qualified instructors and proper equipment), and the time needed for training to be completed. These efforts are necessary to ensure that adequate numbers of qualified personnel will be available for assignment to the new system.

While each domain focuses on separate issues, it is HSI's unique integration aspect that provides the greatest benefit and promotes the practicality of the program. HSI includes the human as an integral element of the new system together with other acquisition factors such as cost, system requirements, schedule, reliability, and vulnerability. Trade-offs and compromises performed among these factors achieve a new level of integration in system design decisions. The five domains of HSI integrate to form a dynamic organizational and management approach to the procurement of today's complex systems. Continued adaptation and refinement of the HSI concept will result in lower life-cycle cost, both in human and financial terms, while concurrently enhancing system capabilities.

5.1 HSI Program Management Actions by Acquisition Phase. We have divided the various actions required to execute the HSI Program, in a given acquisition, into two types of activities: program management actions and technical actions. Program management actions are management activities taken to meet the objectives of the HSI Program and normally affect all domains. Technical actions are those process- and technique-oriented activities required to carry out the HSI Program in a given domain. Categorizing HSI Program actions in this manner permits us to describe those management and technical activities separately. We anticipate that this arrangement should permit a reader to review the management actions first to grasp the general pattern of HSI activities across the acquisition process; and, with that background, to more readily understand the detailed technical activities described for each individual domain.

Accordingly, the following paragraphs will describe the program management actions required in each acquisition phase. This presentation will indicate the general flow of HSI activity through the acquisition process and will be followed by a discussion of the technical actions taken by each domain to effect their portion of the HSI Program. See Exhibit D-8 for an overview of the HSI Process.




The HSI Process focuses on the following three primary objectives:

1. Influence system design to include HSI principles. Achieved by conducting FEA to determine HSI constraints, objectives, and performance criteria, and providing those inputs to the major program documentation that drives system design and development; by influencing source selection in choosing a hardware contractor; and by providing the hardware contractor with a Target Audience Description and requiring the system design to be compatible with those skills, aptitudes, and mental groups.

2. Support selection of system design alternatives. This is accomplished by developing MPT ownership costs for each alternative.

3. Determine affordable and supportable life-cycle requirements. This is achieved by applying the MAPTIDES Methodology to the procurement of vessels, aircraft, and equipment/systems/subsystems (E/S/S)).

Exhibit D-8. The HSI Process Model

a. Project Initiation Phase.

(1) Develop the HSI System Management Plan.

(2) Provide inputs to the Major System Acquisition Project Nomination Memorandum and, as necessary, to the Mission and Cost Analysis and the Technical Assessment.

(3) Initiate an HSI data base to track the HSISMP and data from each domain.

(4) Initiate the MAPTIDES Methodology and the Front-End Analysis.

b. Requirements Definition Phase.

(1) Provide HSI inputs to MNS, strategy objectives for the AP, PORD, and for KDP-1.

(2) Make inputs as necessary to the Mission Functional Analysis and System Cost/Effectiveness Analysis.

(3) Update all HSI Program documentation.

c. Concepts Exploration Phase.

(1) Provide HSI inputs to the PORD/ORD, AP, PMP, TEMP, Integrated Logistic Support Plan (ILSP), RFPs, and KDP-2.

(2) Provide HSI inputs as required to Feasibility Studies, Trade-off Analysis, Development Test Plan, Project Baseline Documentation, Engineering Feasibility Studies, and address critical Test and Evaluation issues.

(3) Provide life-cycle cost estimates for each design alternative.

(4) Update all HSI Program documentation.

d. Demonstration/Validation Phase.

(1) Provide HSI inputs to update all acquisition program documentation, system design, risk analysis, and KDP-3.

(2) Provide HSI inputs as required to the Advanced Development Model demonstrations and validation, Test and Evaluation, and subsystem Compatibility/Trade-off Analysis.

(3) Update all HSI Program documentation.

e. Full Scale Development Phase.

(1) Provide HSI inputs to update all acquisition program documentation, system/subsystem design, and KDP-4.

(2) Provide HSI inputs as required to the Operational Test Plan, Operational Deployment Plan, Engineering Design Model, and Prototype Developmental/Operational Test and Evaluation.

(3) Update all HSI Program documentation.

f. Production Phase.

(1) Coordinate hand-off of personnel and training support plans to Coast Guard institutions providing life-cycle support.

(2) Provide HSI input to production RFPs, system acceptance testing, First Article Developmental/Operational Test and Evaluation, ILSP update, OLSP, and Operational Baseline Configuration Index.

(3) Update all HSI Program documentation.

g. Deployment Phase.

(1) Provide HSI input to ILSP and OLSP updates, ILS Effectiveness Assessment, and Project Transition Plan.

(2) Record lessons learned in all domains.

(3) Preserve the HSI data bases in all domains for use in future acquisitions.

5.2 Human Factors Engineering. HFE is defined as the comprehensive technical effort required to integrate materiel development and acquisition into Coast Guard HSI doctrine in order to ensure system operational effectiveness regarding:

a. Human physical and psychological characteristics

b. Anthropometric data

c. System interface requirements

d. Human performance

e. Biomedical factors

f. Safety factors

g. Manning

HFE deals with the design of Coast Guard materiel to ensure that its use conforms to the capabilities and limitations of the fully equipped range of Coast Guardsmen that operate, maintain, supply, and transport the materiel in the mission environment. HFE is used in system definition, design, development, and evaluation in order to optimize the capabilities and performance of human-machine systems. These capabilities and limitations should be identified early enough in the design effort to impact system development.

5.2.1 HFE Objectives. The primary objective of HFE in the acquisition process is to ensure that Coast Guard materiel, and concepts for their use, conform to the capabilities and limitations of the fully equipped Coast Guardsman to operate, maintain, supply, and transport the materiel in the operational environment in a manner consistent with mission requirements and logistical capabilities. Within the context of Coast Guard materiel acquisition, HFE should include those aspects of systems analysis that determine the role of the Coast Guardsman in the system, defining and developing human-machine interface characteristics, workplace layout, and work environment. Ideally, HFE should be applied during development and acquisition of Coast Guard systems to achieve effective integration of personnel into system design and serve as the interface between the five HSI domains and systems engineering. HFE analyses pertaining to manning levels and user, operator, and maintainability requirements should be used as inputs when considering the Manpower, Personnel, and Training domains within the materiel acquisition process. The HFE effort should seek to develop or improve the personnel-equipment/software interface, to achieve required effectiveness of human performance during system operation/maintenance/control, and to make economical demands upon personnel resources, skills, training, and costs.

5.2.2 Key HFE Issues in Requirements Development. Appendix F lists key HFE issues and can be used as a guide for developing HSI requirements. This list should be tailored to the specific needs of the system under development. The criticality of these key issues will vary for each system. Therefore, OHSIP should determine which key issues are critical and develop HFE documentation for inclusion in both contract and in-house program documents. This documentation should be precise and specific to ensure that contractors fully understand the HFE requirements.

5.2.3 HFE Contributions to Front-End Analysis. FEA plays an important role in generating the information needed for HFE to optimally impact system design and acquisition. The FEA process facilitates identification of HFE constraints, performance criteria, objectives, trade-offs, risks, cost drivers, and other program documentation inputs including strategy and criteria for integrating HFE into design specifications.

In the early (Project Initiation and Requirements Definition) phases of the acquisition process, HFE contributes to the FEA through review of the Baseline Comparison System. During the middle (Concept Development and Demonstration and Evaluation) phases, well established and defined HFE requirements should be incorporated into the system design. In addition, these same HFE requirements should be used to update technical documentation and program management plans. In the later (Full Scale Development, Production, and Deployment) phases, testing should be conducted to identify and remedy HFE-related problems and provide verification that maximum human-system effectiveness has been achieved.

5.2.4 HFE Processes. HFE-related tasks are contingent upon the life-cycle phase under consideration. As tasks are completed within each phase, the products generated provide inputs to the following phase. The exhibits referenced in this section provide a systematic framework for illustrating the process interactions that occur between these inputs, tasks, and products both within and between system phases.

5.2.5 Applicability. The following paragraphs describe the HFE processes (i.e., objectives, inputs, tasks, activities, and products) that occur both within and between the seven system development phases. However, it is not intended that every HFE task or technique referenced herein should be applied to every program or program phase of Coast Guard acquisitions. Section B of the *Coast Guard Human Systems Integration Requirements Document* entitled, Human Factors Engineering Program, provides references, task descriptions, and specific HFE tailoring guidance.

5.2.5.1 Project Initiation Phase. The major objective of the HFE element of the HSI Program within this phase is to ensure that HFE issues, in coordination with those of the other domains, are afforded adequate and timely consideration. HFE planning should, in concert with the Front-End Analysis, begin with a review of the human factors lessons learned that arose during the development and subsequent deployment of the selected BCS. This review should identify preliminary HFE objectives and potential constraints relevant to the envisioned acquisition. Exhibit D-9 illustrates the HFE inputs, tasks, and products associated with this phase.

The HSI documentation impacted by HFE in the phase includes:

a. HSI Systems Management Plan — This plan incorporates specific HFE issues expected to impact the readiness, cost, or performance of the new system.

b. Draft Human Engineering Program Plan (HEPP) — This plan includes the tasks to be performed, HFE KDPs, level of effort, HFE methods and techniques to be used, HFE design concepts to be utilized, and the HFE test and evaluation program in terms of an integrated effort within the total acquisition.

The program documentation impacted and other products generated by HFE in this phase include:

# Human Factors Engineering Domain

Objectives: Ensure that HFE issues are afforded adequate and timely consideration

INPUTS

- 1. Mission Requirements
- 2. Technology Assessment
- 3. HFE Lessons Learned

**Project Initiation Phase**

PRODUCTS

- 1. HFE inputs to HSISMP
- 2. Draft HEPP
- 3. Initial HFE Objectives and Constraints, etc.
- 4. HFE inputs to draft MNS, Draft AP & the Major System Acquisition Project Nomination Memorandum

TASKS & TECHNIQUES:

- 1. Commence FEA - Initiate HFE Planning
- 2. Assist in identifying Baseline Comparison System
- 3. Draft Human Engineering Program Plan
- 4. Develop HFE objectives, constraints, performance criteria, trade-offs, risks, and cost drivers

**Exhibit D-9. HFE in the Project Initiation Phase**

a. Draft MNS — Indicates that HFE techniques are to be applied to the ongoing design effort. The MNS should specify any expected or existing Human Factors Engineering constraints.

b. Draft PORD HFE requirements inputs

c. Draft AP HFE strategy objectives inputs

d. Major System Acquisition Project Nomination Memorandum

The HFE tasks associated with this phase include:

a. Contributions to the FEA through review of lessons learned from the BCS to clarify and identify preliminary HFE objectives and constraints, performance criteria, tradeoffs, risks, cost drivers, and the strategy and criteria needed to integrate HFE into design specifications.

b. HFE expertise should be included in development of the HSI System Management Plan to ensure that HFE issues are fully addressed and to coordinate efforts from the other HSI domain representatives with systems engineering.

5.2.5.2 Requirements Definition Phase. The major objective of the HFE element of HSI within this program phase is to define the HFE systems requirements. Exhibit D-10 illustrates the HFE inputs, tasks, and products associated with this phase.

The HSI documentation impacted by HFE in the phase includes:

a. Draft HEPP update

b. HFE inputs to HSISMP

The program documentation impacted and other products generated by HFE in this phase include:

a. HFE inputs to MNS, strategy objectives for the AP, PORD, and KDP-1

b. HFE inputs as necessary to the mission functional analysis and system cost/effectiveness analysis

The HFE tasks associated with this phase include FEA (BCS review continues). This process refines HFE system objectives and constraints.

5.2.5.3 Concepts Exploration Phase. Following the evaluation of alternative system concepts and the selection of preferred concepts, the major HFE objective within this acquisition phase is to define HFE requirements. Exhibit D-11 illustrates the HFE inputs, tasks, and products associated with this phase.

The HSI documentation impacted by HFE in the phase includes:

# Human Factors Engineering Domain

Objectives: Define HFE Systems Requirements

INPUTS

- 1. Products from Project Initiation Phase
- 2. Mission Functional Analysis

**Requirements Definition Phase**

PRODUCTS

- 1. HEPP Update
- 2. Refined HFE Objectives, and Constraints, etc.
- 3. Inputs to HSISMP
- 4. HFE Inputs to MNS, AP, PORD and KDP-1
- 5. HFE Inputs to Mission Functional Analysis and System Cost/Effectiveness Analysis

TASK & TECHNIQUES:

- 1. Use BCS to refine FEA objectives, constraints, etc. for input to all required program documentation
- 2. Continue FEA
- 3. Update HEPP

Exhibit D-10. Human Factors Engineering in the Requirements Definition Phase

# *Human Factors Engineering Domain*

Objectives: Define HFE requirements for evaluating each alternative system concept and the selection of preferred concepts

INPUTS

- 1. Products from Requirements Definition Phase
- 2. AP strategy objectives

***Concepts Exploration Phase***

PRODUCTS

- 1. HEPP update
- 2. HFE Test & Evaluation Plan
- 3. Identified Human Systems Cost Drivers
- 4. Inputs to HSISMP
- 5. HFE Inputs to: AP, PORD/ORD, PMP, TEMP, ILSP and KDP-2

TASK & TECHNIQUES:

- 1. Analysis of Similar Systems
- 2. Functional Flow Analysis
- 3. Functional Allocation
- 4. Decision-Action Analysis
- 5. Task Analysis
- 6. Time-Line Analysis
- 7. Workload Analysis
- 8. Operational Sequence Analysis
- 9. Controlled Experimentation
- 10. Walk Through
- 11. Risk Analysis
- 12. Simulation Plan

**Exhibit D-11. Human Factors Engineering in the Concept Exploration Phase**

a. HEPP

b. Refined HFE system objectives and constraints

c. HFE inputs to HSISMP

The program documentation impacted and other products generated by HFE in this phase include:

a. MNS update

b. HFE strategy objectives for the AP, PORD, and KDP-2.

The following HFE tasks and techniques are associated with this phase. FEA (BCS review) is also continued.

a. Analysis of Similar Systems: An analysis that is analogous to the BCS review of relevant reference systems.

b. Functional Allocation: A task that determines whether a particular system function or role should be assigned to the machine or human element.

c. Functional Flow Analysis: This analysis models system activities in a sequential manner and describes their interrelationships in a top-down manner.

d. Decision-Action Analysis: The detailed steps inherent in this technique permit the identification of potential cost drivers, training requirements, manning levels, etc., and is of value in determining trade-offs.

e. Task Analysis: A detailed system development process concerned with the identification and description of system tasks as related to training plans and programs, operator workload, etc.

f. Time-Line Analysis: A technique related to functional flow analysis that serves two purposes: (1) determines the time required to adequately perform mission activities and (2) identifies where additional data is required regarding mission activities.

g. Workload Analysis: A technique performed to determine operator task loading and the extent to which performance is impacted and affects decisions regarding task reassignment, hardware redesign, etc.

h. Operational Sequence Analysis: One of the most powerful analytic techniques that is useful in multi-operator and multi-machine system designs. This technique identifies critical activities that can alter the nature of the envisioned tasks.

i. Controlled Experimentation: An efficient data gathering technique that allows for the establishment of causation in the investigation of HFE-related issues.

j. Walk Through: A technique useful at various points in the design process for stepping through task procedures, documents, functional flows, computer programs, etc., to determine omissions in procedures, discontinuities, and inconsistencies.

k. Simulation: Modeling of system-operator tasks and activities to discern potential difficulties that may arise in the fielded system.

l. Mission Profile: A pictorial or graphical representation that shows how the functions of the envisioned mission change over time.

m. Mission Scenario: A narrative account detailing a system's anticipated performance and accounting for personnel, activities, and mission environment.

5.2.5.4 Demonstration and Validation Phase. The major HFE objective within this program phase is to develop and validate the selected HFE system concepts and to reduce technical risk to acceptable levels. Exhibit D-12 illustrates the HFE inputs, tasks, and products associated with this phase.

The HSI documentation impacted by HFE in the phase includes:

a. HEPP

b. HFE inputs to HSISMP

c. HFE Test and Evaluation Requirements developed.

The program documentation impacted and other products generated by HFE in this phase include:

a. HFE inputs to MNS, strategy objectives for the AP, PORD, and for KDP-3.

b. HFE inputs as necessary to the Mission Functional Analysis and System Cost/Effectiveness Analysis.

The HFE tasks associated with this phase include:

# *Human Factors Engineering Domain*

Objectives: Develop and Validate HFE Concept Selected; Reduce Technical Risk to Acceptable Level

INPUTS

- 1. Products from Concept Exploration Phase
- 2. PORD/ORD
- 3. AP
- 4. PMP
- 5. TEMP
- 6. ILSP

***Demonstration & Validation Phase***

PRODUCTS

- 1. Updated HEPP
- 2. Updated HFE Requirements
- 3. Conduct HFE Test & Evaluation
- 4. Inputs to HSISMP and KDP-2

TASKS & TECHNIQUES:

- 1. Analysis of Similar Systems
- 2. Functional Flow Analysis
- 3. Functional Allocation
- 4. Decision-Action Analysis
- 5. Task Analysis
- 6. Time-Line Analysis
- 7. Workload Analysis
- 8. Workload Analysis
- 9. Operational Sequence Analysis
- 10. Controlled Experimentation
- 11. Walk Through
- 12. Risk Analysis
- 13. Simulation
- 14. Fault Tree Analysis
- 15. Failure Mode & Effect Analysis

**Exhibit D-12. Human Factors Engineering in the Demonstration and Validation Phase**

a. Complete BCS Review and Analyses of Similar Reference Systems

b. Functional Allocation

c. Functional Flow Analysis

d. Decision-Action Analysis

e. Task Analysis

f. Time-Line Analysis

g. Workload Analysis

h. Operational Sequence Analysis

i. Controlled Experimentation

l. Analysis of Similar Systems

m. Mission Profile

n. Mission Scenario

o. Walk Through

p. Fault Tree Analysis: A technique suited for analyzing system failure antecedants in order to identify and subsequently correct them.

q. Failure Mode and Effect Analysis: An HFE technique performed in the earlier stages of system acquisition that concentrates on identifying, describing, and classifying potential system failures.

5.2.5.5 Full Scale Development Phase. The major HFE objective in this program phase is to finalize HFE contributions to system design and prepare for production. Exhibit D-13 illustrates the HFE inputs, tasks, and products associated with this phase.

The HSI documentation impacted by HFE in the phase includes:

a. HSISMP

b. HEPP

# Human Factors Engineering Domain

Objectives: Complete HFE contribution to system design; prepare for production

INPUTS

- 1. Products from Demonstration & Validation Phase

## Full Scale Development Phase

PRODUCTS

- 1. Inputs to HSISMP
- 2. Updated HEPP
- 3. HFE inputs to all acquisition program documentation, & KDP-4
- 4. HFE inputs to: Operational Test Plan, Operational Deployment Plan, Engineering Design Model, Prototype Development/Operational Test & Evaluation

TASK & TECHNIQUES:

- 1. Walk Through
- 2. Link Analysis
- 3. Simulation
- 4. Fault Tree Analysis
- 5. Failure Mode & Effect Analysis
- 6. Activity Analysis
- 7. Critical Incident Analysis Study
- 8. Structured Observation
- 9. Questionaire
- 10. Interview
- 11. Participate in all Interface Design Reviews
- 12. Update HFE Detail Design Criteria in T&E Requirements
- 13. Coordinate Solutions to Design Problems from all Domains

**Exhibit D-13. Human Factors Engineering in the Full Scale Development Phase**

The program documentation impacted and other products generated by HFE in this phase include:

a. HFE inputs as required to update all acquisition program documentation, system/subsystem design, and KDP-4

b. HFE inputs as required to the Operational Test Plan, Operational Deployment Plan, Engineering Design Model, Prototype Developmental/Operational Test and Evaluation

The HFE tasks associated with this phase include:

a. Walk Through

b. Link Analysis: A technique useful in designing the layout of instruments or consoles. Its goal is the minimization of hand movements, eye movements, etc., required to perform system tasks and operations.

c. Simulation

d. Fault Tree Analysis

e. Failure Mode and Effect Analysis

f. Activity Analysis: A technique that determines how time is allocated to system tasks. It is another data collection technique used when an experiment is not appropriate.

g. Critical Incident Study: A technique useful in determining accident provocative situations inherent in systems. It proposes methods for their elimination or amelioration.

h. Questionnaire: A data collection technique useful as an adjunct to other techniques that provides system operator and other respondent reports for consideration during any phase of system development.

i. Interview: A data collection technique similar to the questionnaire except that the data collector has one-on-one contact with the system operator or respondent.

5.2.5.6 Production Phase. The major HFE objective in this phase is to address any design changes affecting human performance that involve conceptual, validation, or full scale engineering development HFE-related tasks. Exhibit D-14 illustrates the HFE inputs, tasks, and products associated with this phase.

# Human Factors Engineering Domain

Objectives: Conduct HFE Requirements Analysis and Coordinate Solutions to Design Problems from all Domains

INPUTS

- 1. Products from Full Scale Development Phase

**Production Phase**

PRODUCTS

- 1. Inputs to HSISMP
- 2. HFE Inputs to Update all Acquisition Program documentation
- 3. HFE Inputs to Operational Test Plan, Operational Deployment Plan, Engineering Design Model, Prototype Developmental/Operational Test and Evaluation

TASKS & TECHNIQUES:

- 1. Walk Through
- 2. Simulation

Exhibit D-14. Human Factors Engineering in the Production Phase

The program documentation impacted or products generated by HFE in this phase include HFE inputs as required to production RFPs, system acceptance testing, First Article Developmental/Operational Test and Evaluation, ILSP update, OLSP, and Operational Baseline Configuration Index.

The HFE tasks associated with this phase include:

a. Walk Through

b. Simulation

5.2.5.7 Deployment Phase. The major HFE objective in this phase is to identify the HFE lessons learned and to update the lessons-learned data base for reference during future acquisitions. Exhibit D-15 illustrates the HFE inputs, tasks, and products associated with this phase.

The HSI documentation impacted by HFE in the phase includes:

a. HSISMP

b. HFE inputs into lessons-learned data base

The program documentation impacted or products generated by HFE in this phase include HFE applicable updates to the ILSP and OLSP, ILS Effectiveness Assessment, and Project Transition Plan.

The HFE tasks associated with this phase include:

a. Link Analysis

b. Simulation

c. Activity Analysis

d. Critical Incident Studies

e. Questionnaire

f. Interview

g. Accident Investigation: A means of ascertaining system failures. It draws heavily on other HFE techniques (e.g., simulation, critical incident technique, interview, etc.,) to reach conclusions regarding the nature of the failure.

5.3 System Safety/Health Hazard (SS/HH) Domain. The philosophy underlying the application of the SS/HH domain in system design considers protection of both human and equipment elements to be a critical component of system efficiency, mission effectiveness, and reduced life-cycle cost.

5.3.1 System Safety/Health Hazards Domain Objectives. System Safety Engineering (SSE) identifies, evaluates, and eliminates or controls System Safety and Health Hazards in the design and development of Coast Guard materiel systems.

a. System Safety involves the application of both engineering and management principles, criteria, and techniques to optimize safety within the constraints of operational effectiveness, time, and cost throughout all phases of the new materiel system's life cycle. It involves the identification of hazards and their elimination, or adequate control. System Safety management ensures the planning, implementation, and completion of tasks and activities to meet System Safety requirements, consistent with overall program goals. Safety considerations are incorporated into the human-machine interface design (to satisfy stated tasks, conditions, and standards) and into test and evaluation.

b. The Health Hazards portion of the domain involves the application of biomedical and psychological knowledge and principles to identify, evaluate, and eliminate or control risks to the health and effectiveness of personnel who test, operate, maintain, and support new materiel acquisitions. A Health Hazard is defined as any existing or likely condition, inherent in the operation or use of materiel, that can cause death, injury, acute or chronic illness, disability, or reduced job performance by exposure to:

    (1) Acoustical energy

    (2) Biological substances

    (3) Chemical substance

    (4) Oxygen deficiency

    (5) Psychological stresses

    (6) Radiation energy

    (7) Shock

    (8) Temperature extremes and humidity

    (9) Trauma

# Human Factors Engineering Domain

Objectives: Identify HFE Lessons Learned

INPUTS

- 1. Products from Production Phase

**Deployment Phase**

PRODUCTS

- 1. Identify HFE Lessons Learned
- 2. Inputs to HSISMP

TASKS:

- 1. Link Analysis
- 2. Simulation
- 3. Activity Analysis
- 4. Critical Incident Study
- 7. Questionnaire
- 8. Interview
- 9. Accident Investigation
- 10. Collect and Retain HFE Lessons Learned

**Exhibit D-15. Human Factors Engineering in the Deployment Phase**

(10) Vibration

5.3.2 SS/HH Precedence. The order of precedence for satisfying System Safety requirements and resolving identified hazards is:

a. Designing to eliminate risk

b. Designing for minimum risk

c. Incorporating safety devices

d. Providing warning devices

e. Development of procedures and training

5.3.3 SS/HH Domain Activities. SS/HH domain contributions to system design are necessarily contingent upon the life-cycle phase under consideration. In the early (Project Initiation and Requirements Definition) phases, the SS/HH domain contributes to the FEA through a review of the BCS and other relevant reference systems.

The FEA plays an important role in generating the information needed for the SS/HH domain to optimally impact system design and acquisition. The FEA process facilitates identification of SS/HH requirements, objectives, constraints, criteria, trade-offs, risks, cost drivers, and other program documentation inputs including strategy and criteria for integrating SS/HH considerations into design specifications and hardware/software contractor RFPs. During the middle (Concept Development and Demonstration and Evaluation) phases, well established and defined SS/HH requirements should be incorporated into the technical documentation, program management plans, and hardware/software contracts. In the later (Full Scale Development, Production, and Deployment) phases, testing should be conducted to identify and remedy unresolved SS/HH-related problems and to verify that SS/HH goals have been achieved.

5.3.4 SS/HH Domain Processes. Within this section, SS/HH objectives and recommended processes are presented for each of the seven system design and development phases, since SS/HH domain processes (i.e., the phase-specific tasks, and related products that give direction to the SS/HH program) are contingent upon the life-cycle phase under consideration. As tasks are completed within each program phase, the products generated provide inputs to the following phase. Accordingly, the exhibits referenced in and supported by the following paragraphs provide a framework for illustrating the SS/HH domain process interactions that occur between these inputs, tasks, and products, both within and between acquisition phases.

5.3.5 Applicability. The following paragraphs describe SS/HH domain processes (i.e., objectives, inputs, tasks, activities, and products) that occur both within and between the seven system development phases. The SS/HH tasks described in the following paragraphs are based

largely upon MIL-STD-882B, System Safety Program Requirements, and can be imposed on contractors or in-house design activities to direct and define the conduct of a SS/HH program across the system design life cycle. However, it is not intended that all of the tasks listed in the following exhibits should be applied to every program or program phase. To achieve safe, cost effective acquisition and life-cycle ownership of Coast Guard materiel, tasks should be specifically tailored to each acquisition. Section C of the Coast Guard Human Systems Integration Program Requirements Document provides references and detailed amplification of MIL-STD-882B tasks.

5.3.5.1 Project Initiation Phase. The major objective of the SS/HH element in this phase is to establish and maintain a System Safety Program to ensure that SS/HH issues, in coordination with those of the other domains, are afforded adequate and timely consideration. SS/HH planning should, in concert with the Front-End Analysis, begin with a review of the SS/HH lessons learned that arose during the development and subsequent deployment of the selected Baseline Comparison System. This review should facilitate identification of preliminary SS/HH objectives and potential constraints relevant to the envisioned acquisition. Exhibit D-16 illustrates the SS/HH domain inputs, tasks, and products associated with this phase.

The HSI documentation impacted by the SS/HH domain in this phase includes:

a. HSI Systems Management Plan: Specific HH/SS domain inputs to this document include the content and timeframe for completing the various SS/HH plans and analyses for identifying and eliminating or controlling safety issues and Health Hazards in the new acquisition.

b. Draft System Safety Program Plan (SSPP): This plan serves as the basic tool to be used by the OHSIP in managing an effective SS/HH program. The SSPP should identify all Coast Guard-specified safety program activities and show how the SS/HH program will provide input or preclude duplication of effort.

The program documentation impacted and the products generated in this phase include:

a. Draft MNS: The MNS should specify any expected or existing safety and hazard control constraints and the action proposed to eliminate or reduce those risks.

b. Draft PORD/ORD SS/HH requirements input.

c. Draft AP SS/HH strategy objectives input.

The SS/HH tasks associated with this phase include:

a. Contributions to the FEA through review of lessons learned from the BCS to clarify and identify preliminary SS/HH objectives and constraints, performance criteria, trade-offs, risks, cost drivers, and the strategy and criteria needed to

# SYSTEM SAFETY / HEALTH HAZARDS DOMAIN

Objectives: Establish and maintain a System Safety Program to ensure that SS/HH issues are afforded adequate and timely consideration.

INPUTS

- 1. Mission Requirements
- 2. Technology Assessment
- 3. SS/HH Lessons Learned

**Project Initiation Phase**

PRODUCTS

- 1. SS/HH inputs to HSISMP
- 2. Draft SSPP
- 3. Initial SS/HH Objectives and Constraints, etc.
- 4. SS/HH inputs to draft MNS, Draft AP & the Major System Acquisition Project Nomination Memorandum

TASKS: Commence Front-End Analysis

- 1. FEA - Initiate SS/HH Planning
- 2. Assist in Identifying Baseline Comparison System
- 3. Draft System Safety Program Plan
- 4. Develop SS/HH objectives, constraints, performance criteria, trade-offs, risks, and cost drivers

**Exhibit D-16. SS/HH in Project Initiation Phase**

integrate SS/HH design contributions into system specifications.

b. SS/HH domain expertise should be contributed to OHSIP in development of the HSI System Management Plan to ensure that SS/HH issues are fully addressed and to ensure that applicable SS/HH tasks are imposed as part of the system design effort.

5.3.5.2 Requirements Definition Phase. The major objective of the SS/HH element of the HSI Program in this acquisition phase is to further refine objectives, constraints, and SS/HH requirements. Exhibit D-17 illustrates the SS/HH domain inputs, tasks, and products associated with this phase. The HSI documentation impacted by the SS/HH domain in this phase includes:

a. Draft SSPP update

b. SS/HH domain inputs to HSISMP

The program documentation impacted and the products generated in this phase includes:

a. SS/HH inputs to MNS, strategy objectives for the AP, PORD, and KDP-1

b. SS/HH domain inputs as necessary to the mission functional analysis and system cost/effectiveness analysis

The SS/HH domain tasks associated with this phase include:

a. FEA (BCS review continues) — Refines SS/HH system objectives and constraints

b. Draft SSPP update

5.3.5.3 Concepts Exploration Phase. The major objective of the SS/HH element in this phase is to evaluate each alternative system concept to identify SS/HH limitations and objectives given the existing systems, programs, and force structure. See Exhibit D-18 on the following page.

The HSI documentation impacted by the SS/HH domain in this phase includes:

a. SSPP

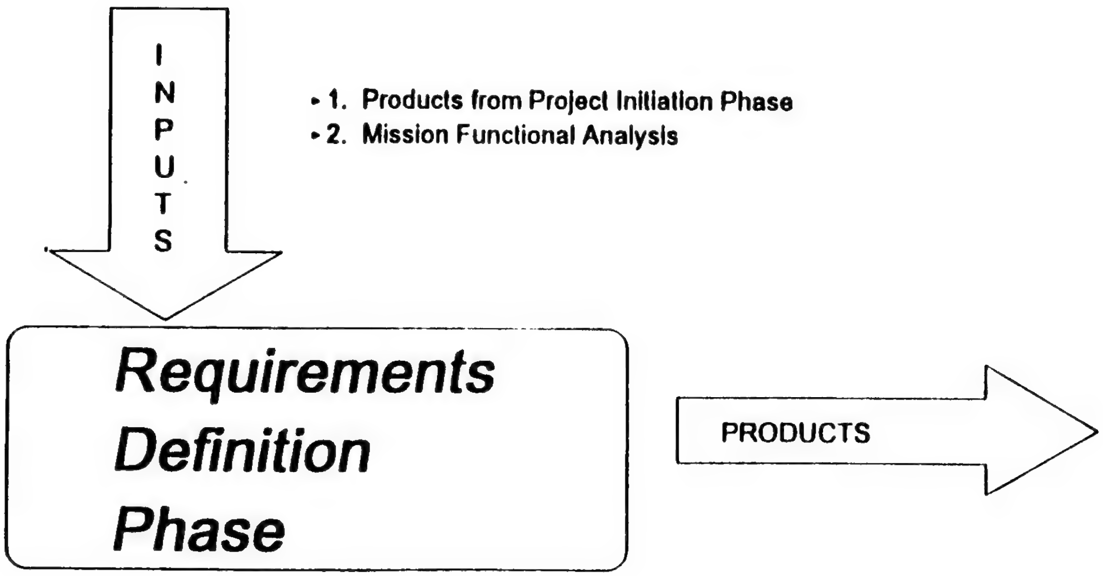
b. Refined SS/HH domain system objectives and constraints

c. SS/HH inputs to HSISMP

The program documentation impacted and other products generated by SS/HH in this phase include:

# SYSTEM SAFETY / HEALTH HAZARDS DOMAIN

Objectives: Further refine SS/HH objectives, constraints, and requirements




Inputs:

- 1. Products from Project Initiation Phase
- 2. Mission Functional Analysis

Products:

- 1. SSPP Update
- 2. Refined SS/HH Objectives, and Constraints, etc.
- 3. SS/HH Inputs to HSISMP
- 4. SS/HH Inputs to MNS, AP, PORD, and KDP-1
- 5. SS/HH Inputs to Mission Functional Analysis and System Cost/Effectiveness Analysis

TASKS: Continue FEA

- 1. Use BCS to refine SS/HH objectives, constraints, requirements, etc., for input to all required program documentation
- 2. Update SSPP

**Exhibit D-17. SS/HH in the Requirements Definition Phase**

# SYSTEM SAFETY / HEALTH HAZARDS DOMAIN

Objectives: Evaluate each alternative system concept to satisfy SS/HH limitations and objectives.

INPUTS

- 1. Products from Requirements Definition Phase
- 2. AP strategy objectives

**Concepts Exploration Phase**

PRODUCTS

- 1. SS/HH update
- 2. SS/HH Test & Evaluation Plan
- 3. Identified SS/HH Cost Drivers
- 4. Inputs to HSISMP
- 5. SSPP Inputs to: AP, PORD/ORD, PMP, TEMP, ILSP and KDP-2
- 6. SS/HH inputs to applicable contractual documents and Risk Analysis

TASKS:

- 1. FEA - BCS review continued
- 2. Perform a Preliminary Hazard Analysis
- 3. Evaluate all proposed materials, design features, maintainer
- 4. Risk Analysis
- 5. Identify SS/HH requirements that may require a waiver
- 6. Identify SS/HH design analysis, test, demonstration and validation requirements
- 8. Document SS/HH recommendations for alternative systems
- 9. Prepare SSE tasks
- 10. Tailor SS/HH Program for later phases

**Exhibit D-18. System Safety/Health Hazards in the Concepts Exploration Phase**

a. PORD/ORD, PMP, TEMP, hardware/software, RFPs, and KDP-2

b. SS/HH strategy objectives for the AP

The SS/HH domain tasks associated with this phase include:

a. FEA (BCS review continued)

b. Update of the System Safety Program Plan

c. Performing a Preliminary Hazard Analysis (PHA) to identify hazards associated with each alternative

d. Evaluating all considered materiels, design features, maintenance, servicing, operational concepts, and environments of the new system that should affect safety throughout the system life cycle

e. Highlighting special areas of safety considerations, such as system limitations, risks, and man-rating requirements

f. Identifying safety requirements that may require a waiver during the system life cycle

g. Identifying safety design analysis, test, demonstration, and validation requirements

h. Documenting the System Safety analyses, results, and recommendations for each promising alternative system concept

i. Preparing a summary report of the results of the SSE tasks conducted during the phase to support the decision making process

j. Tailoring the SSE program for subsequent phases and including detailed requirements in the appropriate contractual documents

5.3.5.4 Demonstration and Validation Phase. The major SS/HH domain objectives during this phase is to tailor of SS/HH tasks to accommodate the specific acquisition. Procurements range from extensive study and analyses through hardware development to prototype testing, demonstration, and validation. Exhibit D-19 illustrates the HH/SS domain inputs, tasks, and products associated with this phase.

The HSI documentation impacted by the SS/HH domain in this phase includes:

a. SSPP update

# SYSTEM SAFETY / HEALTH HAZARDS DOMAIN

Objectives: Develop and Validate Concept Selected; Reduce Technical Risk to Acceptable Level

INPUTS

- 1. Products from Concept Exploration Phase
- 2. PORD/ORD
- 3. AP
- 4. PMP
- 5. TEMP
- 6. ILSP

**Demonstration & Validation Phase**

PRODUCTS

- 1. Updated SSPP
- 2. Updated SS/HH Requirements
- 3. Conduct SS/HHTest & Evaluation
- 4. Inputs to HSISMP and KDP-3

TASKS:

- 1. Complete BCS Review
- 2. Establish SSE requirements for system design and criteria
- 3. Trade-off studies to determine System Safety requirements and risks and recommend system design changes as warranted
- 4. Prepare SHA
- 5. Perform SSHA
- 6. Perform OSHA
- 7. Identify critical SS/HH elements (i.e., parts, assemblies, production techniques, procedures, facilities, testing, and Inspection requirements)
- 8. Document System Safety analyses and alternative system concepts
- 9. Prepare summary review report regarding the results of the SS/HH tasks conducted during this program phase
- 10. Tailor SS/HH Program for subsequent phases

**Exhibit D-19. System Safety/Health Hazards in the Demonstration and Validation Phase**

b. SS/HH domain inputs to HSISMP

The program documentation impacted and the products generated in this phase include:

a. SS/HH domain inputs to KDP-3

b. SS/HH domain inputs as necessary to the mission functional analysis and system cost/effectiveness analysis

The SS/HH domain tasks associated with this phase include:

a. Completing preparation or update of the SSPP

b. Establishing SSE specifications for system design and criteria and verifying that these requirements have been met

c. Participating in trade-off studies to reflect the impact on System Safety requirements and risk

d. Recommending system design changes based on these studies to ensure optimum safety consistent with performance and system requirements

e. Completing preparation or update the PHA to evaluate the configuration to be tested

f. Preparing a System Hazard Analysis (SHA) report of the test configuration considering the planned test environment and methods

g. Performing detailed hazard analyses (SHA or SSHA) of the design to assess the risk involved in test operation of the system hardware and software

h. Recommending redesign or other corrective action based on evaluation of the results of safety tests, failure analyses, and mishap investigations

i. Performing operating and support hazard analyses of each test, and reviewing all test plans and procedures. Ensuring that hazards identified by analyses and tests are eliminated or their associated risk minimized

j. Identifying critical parts and assemblies, production techniques, assembly procedures, facilities, testing, and inspection requirements that may affect safety and ensure that:

(1) Adequate safety provisions are included in the planning and layout of the production line

(2) Adequate safety provisions are included in inspections, tests, procedures, and checklists for quality control of the equipment being manufactured

(3) Production and manufacturing control data contain required warnings, cautions, and special safety procedures

(4) Testing and evaluation are performed on early production hardware to detect and correct safety deficiencies

(5) Minimum risk is involved in accepting and using new design, materiels, and production and test techniques

k. Establishing analysis, inspection, and test requirements for government furnished equipment (GFE) or contractor-furnished equipment to verify prior to use that applicable SSE requirements are satisfied

l. Reviewing logistics support publications for adequate safety considerations, and ensuring the inclusion of applicable Department of Transportation (DoT), Environmental Protection Agency (EPA), and Occupational Safety and Health Administration (OSHA) requirements

m. Ensuring SSE requirements are incorporated into the system specification/design document

n. Preparing summary report of the results of SSE tasks conducted to support the decision making process

o. Continuing to tailor the SSE program

5.3.5.5 Full Scale Development Phase. The major SS/HH objective in this program phase is to finalize SS/HH domain contributions to system design and prepare for production. Exhibit D-20 illustrates the SS/HH domain inputs, tasks, and products associated with this phase.

The HSI documentation impacted by the SS/HH domain in this phase include:

a. HSISMP

b. SSPP updated

The program documentation impacted and the products generated in this phase include:

# SYSTEM SAFETY / HEALTH HAZARDS DOMAIN

Objectives: Finallize SS/HH domain contributions to system design and prepare for production

INPUTS

- 1. Products from Demonstration & Validation Phase

**Full Scale Development Phase**

PRODUCTS

- 1. Inputs to HSISMP
- 2. Completion or updates to SSPP
- 3. SS/HH domain inputs to all acquisition program documentation, & KDP-4
- 4. SS/HH inputs to: Operational Test Plan, Operational Deployment Plan, Engineering Design Model, Prototype Development/Operational Test & Evaluation
- 5. Update SSHA, SHA, OSHA

TASKS:

- 1. Review preliminary engineering documentation to insure that SS/HH issues are resolved.
- 2. Trade-off studies
- 3. Recommend required design changes and control procedures
- 4. Participate in technical design and program reviews
- 5. Review logistic support publications
- 6. Verify adequacy of safety and warning devices,and related equipment
- 7. Tailor SS/HH program requirements for the Production Phase

**Exhibit D-20. System Safety/Health Hazards in the Full Scale Development Phase**

a. SS/HH domain inputs as required to update all acquisition program documentation, system/subsystem design, and KDP-4

b. SS/HH domain inputs as required to the Operational Test Plan, Operational Deployment Plan, Engineering Design Model, Prototype Developmental/Operational Test and Evaluation

The SS/HH domain tasks associated with this phase include:

a. Completing preparation or update of the SSPP

b. Reviewing preliminary engineering designs to ensure safety design requirements are incorporated and hazards identified are eliminated or reduced to an acceptable level

c. Reviewing appropriate engineering documentation to ensure safety considerations have been incorporated

d. Identifying, evaluating, and providing safety considerations for trade-off studies

e. Performing or updating the SSHA, SHA, Operating and Support Hazard Analysis (O&SHA), and safety studies concurrent with the design/test effort to identify design and/or operating and support hazards. Recommend any required design changes and control procedures

f. Performing an O&SHA for each test, and reviewing all test plans and procedures

g. Participating in technical design and program reviews and presenting the SHA, SSHA, and/or O&SHA

h. Recommending redesign or other corrective actions based on identification and evaluation of the effects of storage, shelf-life, failure analyses, and mishap investigations

i. Reviewing logistic support publications for adequate safety considerations and ensuring the inclusion of applicable DoT, EPA, and O&SHA requirements

j. Verifying the adequacy of safety and warning devices, life support equipment, and personal protective equipment

k. Identifying the need for safety training and providing safety inputs to training courses

l. Providing System Safety surveillance and support of test unit production and planning for production and employment. Identifying critical parts and assemblies, production techniques, assembly procedures, facilities, testing, and inspection requirements that may affect safety and ensuring that:

(1) Adequate safety provisions are included in the planning and layout of the production line.

(2) Adequate safety provisions are included in inspections, tests, procedures, and checklists for quality control of the equipment being manufactured.

(3) Production and manufacturing control data contain required warnings, cautions, and special safety procedures.

(4) Testing and evaluation are performed on early production hardware to detect and correct safety deficiencies.

(5) Minimum risk is involved in accepting and using new design, materiels, and production and test techniques.

m. Ensuring that procedures developed for system test, maintenance, operation, and servicing provide for safe disposal of expendable hazardous materiel

n. Updating SSE requirements in system specification/design documents

o. Preparing a summary report of the results of the SSE tasks to support the decision making process

p. Tailoring SSE program requirements for the Production and Deployment Phase

5.3.5.6 Production Phase. The major SS/HH domain objective in this phase is to address any design changes affecting System Safety or Health Hazard control that involve SS/HH domain-related tasks in the conceptual, validation, or full-scale engineering development phases. Exhibit D-21 illustrates the SS/HH domain inputs, tasks, and products associated with this phase.

The program documentation impacted or products generated by the SS/HH domain in this phase include SS/HH domain inputs as required to production RFPs, system acceptance testing, First Article Developmental/Operational Test and Evaluation, ILSP update, OLSP, and Operational Baseline Configuration Index.

The SS/HH domain tasks associated with this phase include:

a. Completing preparation or updating the SSPP

# SYSTEM SAFETY / HEALTH HAZARDS DOMAIN

Objectives: Address design changes affecting System Safety or Health Hazard control that involve conceptual, validation, or Full Scale Development SS/HH domain-related tasks

INPUTS

- 1. Products from Full Scale Development Phase

**Production Phase**

PRODUCTS

- 1. Inputs to HSISMP
- 2. SS/HH inputs to update all Acquisition Program documentation
- 3. SS/HH inputs to RFPs, OT&E, ILSP, OLSP, and Operational Baseline Configuration Index

TASKS:

- 1. Identify critical parts and assemblies, production techniques, assembly procedures, facilities, testing, and inspection requirements that may affect safety and ensure that adequate safety provisions are included during manufacturing
- 2. Conduct safety tests and evaluations
- 3. Review test plans and procedures
- 4. Review OSHA technical data for warnings,cautions, and special procedures

**Exhibit D-21. System Safety/Health Hazards in the Production Phase**

b. Identifying critical parts and assemblies, production techniques, assembly procedures, facilities, testing, and inspection requirements that may affect safety and ensuring that:

   (1) Adequate safety provisions are included in the planning and layout of the production line.

   (2) Adequate safety provisions are included in inspections, tests, procedures, and checklists for quality control of the equipment being manufactured.

   (3) Production and manufacturing control data contain required warnings, cautions, and special safety procedures.

   (4) Testing and evaluation are performed on early production hardware to detect and correct safety deficiencies.

   (5) Minimum risk is involved in accepting and using new design, materiels, and production and test techniques.

c. Verifying that test and evaluation are performed on early production hardware to detect and correct safety deficiencies

d. Reviewing all test plans and procedures. Ensuring that hazards identified by test and analysis are eliminated or associated risk reduced to an acceptable level

e. Reviewing technical data for warnings, cautions, and special procedures identified as required by O&SHA for safe operation, maintenance, servicing, storage, packaging, handling, and transportation

5.3.5.7 Deployment Phase. The major SS/HH domain objective in this phase is to identify the SS/HH lessons learned and to update the lessons-learned data base for reference during future acquisitions. Exhibit D-22 illustrates the SS/HH domain inputs, tasks, and products associated with this phase.

The HSI documentation impacted by SS/HH in the phase includes:

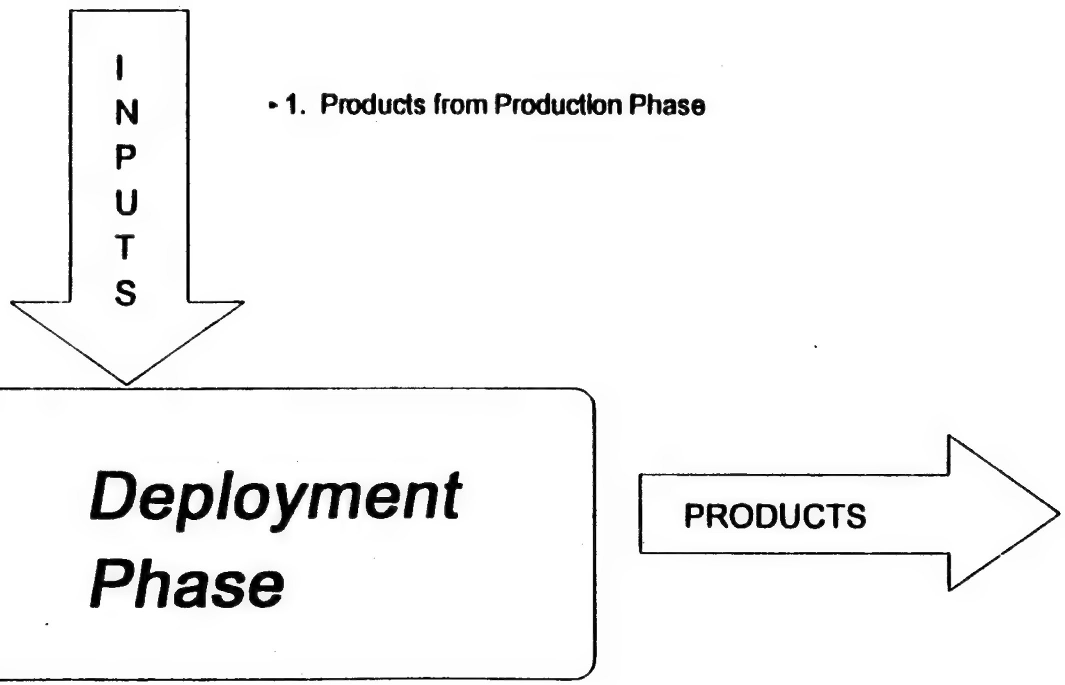
a. HSISMP

b. SS/HH domain inputs into lessons-learned data base

The program documentation impacted or products generated by the SS/HH domain in this phase include SS/HH domain updates as required to the ILSP and OLSP, ILS Effectiveness Assessment, and Project Transition Plan.

# SYSTEM SAFETY / HEALTH HAZARDS DOMAIN

Objectives: Prepare for unrestricted operations and hand off to operational commander




- 1. Products from Production Phase

- 1. SS/HH inputs to HSISMP
- 2. Identified SS/HH Lessons Learned

## TASKS:

- 1. Review procedures and monitor results of periodic field inspections to ensure acceptable maintainence of safety standards
- 2. Review deployment plans and procedures
- 3. Update hazard analyses
- 4. Evaluate results of failure analysis
- 5. Conduct applicable safety reviews

Exhibit D-22. System Safety/Health Hazards in the Deployment Phase

The SS/HH tasks associated with this phase include:

a. Reviewing procedures and monitoring results of periodic field inspections to ensure acceptable levels of safety are maintained. Identifying major or critical characteristics of safety significant items that deteriorate with age, environmental conditions, or other factors.

b. Reviewing all deployment plans and procedures. Ensuring that hazards identified by analysis are eliminated or associated risk reduced to an acceptable level.

c. Performing or updating hazard analyses to identify new hazards that may result from design changes. Ensuring that safety implications of the changes are considered in all configuration control plans.

d. Evaluating results of failure analyses and mishap investigations. Recommending corrective actions.

e. Monitoring the system throughout the life cycle to determine the adequacy of the design and operating/maintenance/emergency procedures.

f. Conducting a safety review of proposed new operating and maintenance procedures, or changes, to ensure the procedures, warnings, and cautions are adequate and inherent safety is not degraded.

g. Documenting hazardous conditions and system deficiencies for development of follow-on requirements for modified or new systems.

h. Updating safety documentation to reflect safety lessons learned.

i. Evaluating the adequacy of safety and warning devices, life support equipment, and personal protective equipment.

## 5.4 Manpower, Personnel, and Training Domains.

5.4.1 Introduction. In describing the recommended model for the life-cycle management domains of HSI, OGDEN has tailored a unique set of MPT action steps to the seven phases of the Coast Guard acquisition process. This application has resulted in a new methodology we have coined *MAPTIDES*, which stands for Manpower, Personnel and Training Integration in the Design of Systems. See Exhibit D-8 for an overview of the HSI process and how MAPTIDES integrates with other major HSI elements. MAPTIDES is a subset of the HSI process and a unique Coast Guard methodology designed to fully describe all actions required to determine MPT acquisition and life-cycle requirements related to the design, development, and support of new materiel systems.

The MAPTIDES Methodology has three specific applications depending on the type of materiel procured:

a. Equipment/System/Subsystem (E/S/S) Application

b. Aviation Application

c. Total Vessel Application.

Each application has a five-action-step process that describes specifically how to determine MPT requirements in each case. The E/S/S and Aviation Applications use the same five steps, while the Total Vessel Application uses a distinctly different five-step process.

When the MAPTIDES Methodology is used in the Aviation Application, it encompasses MPT requirements for aircraft and any other aviation equipment (i.e., aviation E/S/S) procured through the Coast Guard acquisition system. The Total Vessel Application of MAPTIDES applies MPT requirements related only to the vessel and its support. The E/S/S Application covers all remaining systems procured through the Coast Guard acquisition process (e.g., LORAN equipment and radars for shore installations).

The MAPTIDES Methodology is sequenced to develop manpower and personnel quality requirements first and to use those requirements as inputs in developing the Coast Guard Training Plan (CGTP). The CGTP displays all Manpower, Personnel, and Training domain requirements for the new acquisition. The following paragraphs will describe the MAPTIDES Methodology for determining MPT domain requirements in each application. Once the methodology is described, we will present the timing required by integrating the MAPTIDES Methodology into the Coast Guard's seven-phase acquisition process.

5.4.2 Manpower Domain. Manpower is the human resource requirements and authorizations (i.e., military billets and civilian positions) needed for the operation, maintenance, and support of each new materiel system, including both billet/position quantity and quality (quality refers to occupational specialty, pay grade, and special skill requirements). This domain requires an evaluation of the manpower changes generated by each proposed new system, comparing the new manpower needs with those of any older system(s) being replaced, and an assessment of the impact of the changes on the total manpower limits of the Coast Guard. If, given manpower priorities established by the Coast Guard Headquarters, materiel systems cannot be supported by projected manpower resources, then changes in system design, organization, or doctrine must be made to achieve affordability. In the materiel acquisition process, manpower analysis and actions are necessarily conducted in conjunction with Coast Guard force structure and budget processes.

The Coast Guard maintains a personnel classification system that defines the various career fields performing the work required to meet manpower requirements. In determining the quality associated with new billets/positions, the manpower analyst should refer to the classification system a guide for standardization. The classification system is a direct link between the manpower and personnel domains.

The primary factors that determine manpower costs are the number, complexity, and frequency of tasks that require operators, maintainers, and support personnel. These factors determine the quantity of personnel required, aptitude levels, experience, and degree of specialized training required of individuals to perform each task. As a result, billets/positions drive the number and quality of personnel required to meet Coast Guard requirements.

Manpower planning is by no means an "exact science." There is no single, absolute relationship between hardware and manpower. The operational scenario and maintenance concept are primary drivers of most Coast Guard manpower requirements. For vessels the size of cutters, the watch station requirements are the principal manpower driver. Increased system utilization means increased maintenance requirements for a fixed hardware design. The quantitative requirements are sensitive to the qualitative attributes of assigned personnel (e.g., three personnel at paygrade E-6 may perform the same workload as four individuals at paygrade E-5 because of the increased skill level). Policy decisions such as continuous manning and key personnel redundancy may also create manpower requirements not directly related to the design of equipment.

The manpower planning process includes the forecasting of manpower requirements and personnel availability, as well as the development of alternative policies, in order to resolve remaining discrepancies. In principle, a match of manpower requirements and personnel availability can be obtained not only by adapting either the requirement or the availability, but also by adapting a mix of both. The MAPTIDES Methodology, which incorporates the MPT requirements determination processes, trade-off analyses, and Coast Guard-wide MPT supportability assessments, is at the focal point of this matching process.

5.4.2.1 Manpower Analyses Required. The Manpower Domain requires iterative analyses as an integral part of the new system design process, starting early in the Program Initiation Phase.

a. By selecting a Baseline Comparison System as an initial step (and before conducting a complete BCS analysis), the known manpower requirements of the old system can be used to make a rough Initial Estimate of Manpower requirements for the new system. See Appendix H for IEM format. This estimate will be sufficient to start the personnel and training analysis and for planning until a more complete BCS analysis can be done. "Best available" information will be used in each iterative analysis as the system design matures.

b. A Target Audience Description is developed from the IEM based on the Coast Guard occupations, officer specialties, and similar civilian career fields/pay plans required for the new procurement. The primary purpose of the TAD is to provide human design criteria for the hardware/software contractor who will design and build the new acquisition. The TAD provides an official statement of the capabilities and limitations of personnel expected to man the new procurement when fielded. The contractor must meet this criteria when designing and developing the new acquisition. The TAD should be updated as information is refined.

The TAD delineates the quantity and quality of active and reserve military, civil servants, and contractors who will most likely operate, maintain, and support the new procurement when fielded. This document describes the range of individual qualifications on all relevant physical, mental, physiological, biographical, and motivational dimensions. The TAD relates these characteristics to the ability of the human to accomplish tasks associated with the operation, maintenance, and support of the system. Early identification of these HSI concerns increases the flexibility available to resolve the issues in terms of design, affordability, and supportability. The manpower portion of the TAD includes the following.

(1) Number authorized/assigned by paygrade for military/civilian

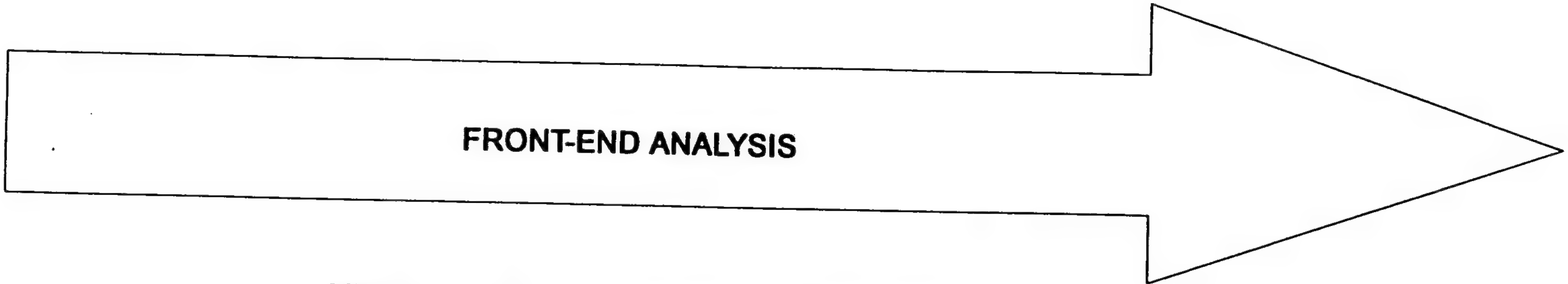
(2) Number authorized CONUS/OCONUS by paygrade

c. The Front-End Analysis commences as soon as practical after the Project Initiation Phase begins. See Exhibit D-23 for a description of FEA. The Front-End Analysis calls for a complete side-by-side systems analysis of the BCS, and will develop initial HSI requirements, including manpower constraints and limitations, objectives, trade-offs, risks, and cost drivers. The results of the analysis will be used to update the IEM and to provide inputs to the major program documentation (e.g., MNS, AP, PORD/ORD, PMP, TEMP, and ILSP).

d. Analysis of each system design alternative considered is required to determine the Manpower requirements of each alternative to be used in the concept selection decision. From an HSI perspective (and there may be other considerations as well), the alternative should be selected that offers the best combination (i.e., best value to the Coast Guard) of high system performance, low human ability requirements (i.e., number of people, aptitudes, mental group, and training burden), and low life-cycle costs.

e. The MAPTIDES Methodology commences with data collection at the same time as the Front-End Analysis. Both MAPTIDES and Front-End Analyses are conducted by the office responsible for the HSI Program. See Exhibit D-24 for a description of the MAPTIDES Methodology. MAPTIDES and the FEA continue in parallel. While the FEA determines HSI constraints, objectives, etc., that will become inputs to the major program documentation, MAPTIDES provides the detailed procedures for conducting the BCS analysis (thereby also contributing to the development of information provided as inputs to major program documents) and the remaining processes necessary to determine life-cycle Manpower requirements for the new system.

When the ILS Manager is assigned to the PM staff in the Concepts Exploration Phase, OHSIP hands-off the information developed in the Front-End Analysis, the IEM, and any other data available that would assist the ILS Manager in




## Mission and Support System Definition Tasks

Task 1 Use Study—Documents deployment scenario, mission frequency and duration, service life, operational environment

Task 2 Mission Hardware, Software, and Support System Standardization— Defines design constraints and provides supportability inputs.

Task 3 Comparative Analysis—Develops BCS to project supportability-related factors and identify targets for improvement, identify high cost and readiness drivers, document risk, and determine IEM. The MAPTIDES Methodology is used to conduct the BCS analysis for MPT domains. Develops HSI constraints, limitations, objectives, and performance criteria for each domain.

Task 4 Technology Opportunities—Identifies technological advancements and state-of-the-art design approaches for possible use in the new system; and recommends design objectives, updates, and evaluation of technical risk.

Task 5 Supportability and Supportability - Related Design Factors — Evaluate Support characteristics of alternative design and operational concepts; determines support design objectives, goals, and thresholds; and identifies support constraints.

Major Objectives of FEA:

1. Determine HSI constraints, limitations, supportability, objectives, and performance criteria in each domain as Inputs to the major program documentation that drives the system design.

2. Provide the resulting information as a hand-off to the ILS Manager in the Concepts Exploration Phase to facilitate completion of required LSA documentation and initiate the the interface between HSI and the ILS process.

# Front-End Analysis Process

MAPTIDES -- MPT REQUIREMENTS DETERMINATION → **Life-Cycle Support**

| E/S/S* and Aviation Procurements | Total Vessel Procurements | Documentation Produced: E/S/S and Aviation | Documentation Produced: Total Vessel |
|---|---|---|---|
| Step - 1<br>Collect Preliminary Data<br>Conduct Systems Analysis | Step - 1<br>Collect Preliminary Data<br>Conduct Systems Analysis | Initial Estimate of Manpower (IEM) | IEM |
| Step - 2<br>Conduct Comparability Analysis | Step - 2<br>Conduct Manpower Engineering Study | MPT Concept Document (MPTCD) | Preliminary Manpower Report (PMR) |
| Step - 3<br>Develop MPT Concepts | Step - 3<br>Determine Operational Manpower Requirements | MPT Resource Requirements Document (MPTRRD) | Preliminary Vessel Manpower Document (PVMD) |
| Step - 4<br>Develop MPT Resource Requirements | Step - 4<br>Develop New Vessel Training Requirements | Preliminary Aircraft Manpower Document (PAMD) | Coast Guard Training Plan |
| Step - 5<br>Develop Program Documentation Inputs | Step - 5<br>Develop Program Documentation Inputs | Coast Guard Training Plan | |

Major Objectives of the MAPTIDES Methodology is to:

1. Develop affordable and supportable MPT requirements for life-cycle support of the system.
2. Contribute to development of information included in major program documentation.
3. Provide MPT ownership costs and other MPT evaluations of each design alternative for consideration in selecting the most cost effective design concept.
4. Establish effective interfaces with all other applicable organizations having acquisition responsibilities.

* E/S/S - Equipment/System/Subsystem

## MAPTIDES Methodology

completing the remaining ILS tasks. This hand-off initiates the interface required between the HSI Program and the ILS process.

(1) While MAPTIDES is working to achieve the objectives noted in Exhibit D-24, the ILS Manager will be taking a series of actions, among others, in executing the ILSP to cause the hardware contractor to develop appropriate deliverables in the following maintenance-related areas.

(a) Repair Parts

(b) Technical Manuals

(c) Maintenance Training Course Documentation (i.e., Course Curriculum)

(d) Tools and Test Equipment.

(2) Even though MAPTIDES does not duplicate these areas, there is interface coordination required from time-to-time in sharing Manpower data to ensure that both the OHSIP and ILS Manager are using the latest information and neither is duplicating effort.

5.4.2.2 MAPTIDES Documentation. The MAPTIDES Methodology continues through the five-action-step process during the Concepts Exploration and Demonstration/Validation Phases (and updates in the remaining phases) to produce the following Manpower documentation.

a. For Aviation and E/S/S Procurements, the following Manpower documentation is developed:

(1) MPT Concept Document (MPTCD) — This document contains manpower and maintenance concepts derived from the quantitative manpower resource requirements (i.e., number of required operators, maintainers, and other non-training manpower) for each configuration of the new system. See Appendix I for format. The following products are developed in producing the MPTCD:

(a) Installation Schedule

(b) Transitioning Activity Stand-Up, Phase-Out Schedule

(c) Other Manpower Requirements

The concept document is based on a single unit of the system and is the conceptual basis for developing the aggregate manpower requirements displayed in the MPT Resource Requirements Document.

(2) MPT Resource Requirements Document (MPTRRD) — This document details the aggregate quantitative and qualitative billets/positions and costs that are driven by the Manpower concept. The document displays MPT billets/positions and costs by fiscal year until the system is totally deployed. Both the MPTCD and MPTRRD are iterative processes. These processes are dynamic enough that the documents should indicate the point in the acquisition process when they were prepared. Products developed in producing the MPTRRD include the following:

(a) Coast Guard-Wide Organizational Manpower Requirements

(b) Coast Guard-Wide Intermediate Maintenance Activity Support Requirements

(c) Other Support (Non-Training) Manpower Requirements

(d) Student Billet Requirements

(e) Instructor Billet Requirements

(f) Staff Support Billet Requirements

(3) Preliminary Aircraft Manpower Document (PAMD) — This document is prepared for aircraft procurements only, and is a statement of total manpower required to support the entire buy of aircraft by fiscal year, including flight crews, administrative support, and maintenance support at the organizational, intermediate, and depot level depending on the maintenance concept. The PAMD should be developed by the OHSIP, reviewed by the Program Sponsor, PM, and the Office of P, and approved by the Chief of Staff (G-CPA). The approved PAMD should be used to initially man the new aircraft organization and its support. After operating with this document for about 2 years, it should be reviewed, updated, and promulgated as an Aircraft Manpower Document (AMD).

b. In vessel acquisitions, the following Manpower documentation is developed:

(1) Preliminary Manpower Report (PMR) — This report will update the IEM and contains a description of the new vessel, an explanation and justification of the Baseline Comparison Model (BCM), an estimate of new vessel manpower requirements, and probable program trade-offs (i.e.,

equipment options for the new vessel). The manpower estimate should be in the format described in Appendix H.

(2) Preliminary Vessel Manpower Document (PVMD) — The PVMD can be developed using the Navy Manpower Requirements System (NMRS) Model, or by contractor. The Coast Guard is currently using this model to produce Manpower Documents for existing Coast Guard Cutters. Appendix J includes the kind of information that NMRS can provide, and it shows the format used to generate Ship Manpower Documents (SMDs). The analyst collects workload and other specific data required to run the model and produce the PVMD. The PVMD will be similar in format to SMDs, but modified as necessary to account for differences in manpower coding structure, organization of work centers, etc. Like the PAMD, the PVMD should be developed by the OHSIP, reviewed by the Program Sponsor, PM, and the Office of P, and approved by G-CPA. After operating with this document for about 2 years, it should be reviewed, updated, and promulgated as a Vessel Manpower Document (VMD).

5.4.2.3 <u>MAPTIDES Methodology for Determining Manpower Domain Requirements</u>. Analyses of Manpower requirements are completed in each of two different applications of the MAPTIDES Methodology (see Exhibit D-24):

a. Both Aviation and E/S/S procurements share the same application of the methodology.

b. Total Vessel acquisitions use a distinctly different application.

5.4.2.3.1 <u>E/S/S Application</u>. This application is used for all procurements acquired through the Coast Guard acquisition process, except for Aviation E/S/S and vessel procurements. Refer to Exhibit D-25 for E/S/S MAPTIDES MPT requirements determination methodology.

a. Step 1. Collect Preliminary Data/Conduct Systems Analysis

(1) Data is collected and reviewed by the analyst on the new E/S/S requirements, concepts, functions, performance goals, performance standards, and equipment.

(2) A systems analysis is performed to select a BCS. The BCS will be based either on the predecessor system or a group of comparable existing systems that best match the new system requirements, concepts, performance standards, and equipment. Billet/position requirements data are collected on the platform/activities where the BCS is installed.

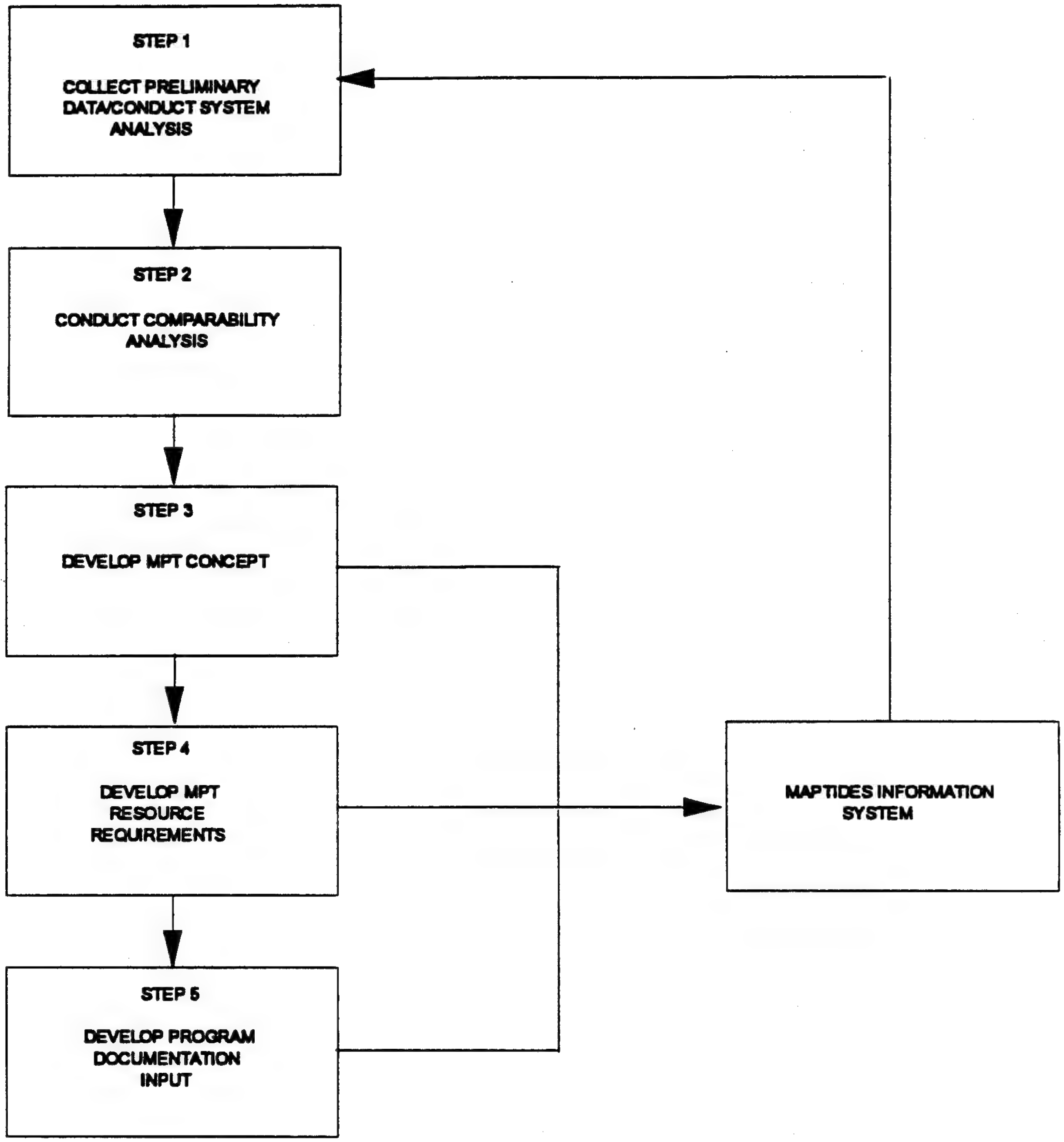



**Exhibit D-25. E/S/S and Aviation MANTIDES MPT Requirements Determination Methodology**

(3) Step 1 initiates development of the application's data base and audit trail used to track the design effort throughout the remainder of the project.

b. Step 2. Conduct Comparability Analysis

(1) This step consists of a series of procedures to assess differences in resource requirements between the BCS and the new system. This is done by comparing known parameters of the BCS with characteristics and performance standards of the new E/S/S.

(2) A comparison is done of both operator and maintainer functional tasks between the BCS and new E/S/S. This comparability analysis traces the source of resource changes to differences in requirements, concepts, performance standards, and equipment.

(3) Estimates of key Manpower data elements for new systems are determined from comparable BCS values through the formulation of deltas. A delta is the estimated change in BCS values dictated by design, operational, and functional changes in the new system. See Appendix K for a discussion of how to determine deltas.

c. Step 3. Develop the Manpower Concept

This step consists of three substeps and results in development of the MPT Concept Document.

(1) The configuration(s) and installation schedule for the new E/S/S are developed. This provides the analyst with the number and types of platforms/activities where the new E/S/S will be installed, as well as the number of installations by fiscal year. This information is available from the Program Sponsor and will be included in the MNS and AP.

(2) The Manpower concept is derived from the quantitative and qualitative manpower resource requirements for each unique E/S/S configuration. These requirements are grouped into three categories:

(a) Maintenance manpower

(b) Operator manpower

(c) Other non-training manpower

(3) The Manpower portion of the MPT Concept Document is prepared by the analyst using data from the previous two substeps. See Appendix I for

MPTCD format. This concept document provides basic input to the MPT Resource Requirements Document.

d. Step 4. Develop Manpower, Personnel, and Training Resource Requirements Document

In Step 3, the Manpower concept for operating, maintaining, and supporting a single E/S/S configuration was determined. In Step 4, Coast Guard-wide Manpower resource requirements are determined and displayed by location and by fiscal year.

e. Step 5. Develop Program Documentation Input

(1) The MAPTIDES Methodology is a structured and systematic means of addressing the many Manpower issues in the Coast Guard acquisition process. One principal value of this methodology is that it produces a single data source to be used by OHSIP to meet all Manpower documentation requirements, thus promoting consistency and comparability.

(2) Manpower inputs are required in all major program documentation and should be updated prior to each Key Decision Point.

5.4.2.3.2 Aviation Application. This application is similar to the E/S/S application. See Exhibit D-25 for the basic steps in this application. The Exhibit describes procedures for applying the MAPTIDES Methodology to determine Manpower requirements for aircraft and Aviation E/S/S acquisitions. The Aviation Application is composed of the following five steps that together provide a structure for Manpower planning, analysis, and documentation during the Coast Guard acquisition process.

a. Step 1. Collect Preliminary Data and Conduct Systems Analysis

This step consists of two substeps. The analyst performs the following:

(1) Collects and reviews data on new Aviation E/S/S requirements, concepts, functions, performance goals, performance standards, and equipment.

(2) Conducts systems analysis aimed at identifying a suitable BCS.

Data from this step are used to initiate development of the application's data base and audit trail. This data is also used in Step 2.

b. Step 2. Conduct Comparability Analysis

This step compares known parameters of the BCS with those of the new Aviation E/S/S collected in Step 1. The objective is to quantify resource differences between the two E/S/S. This is accomplished by comparing functional tasks (both operator and maintainer) of the BCS with the new E/S/S. This procedure will trace the source of resource changes to differences in requirements, concepts, performance standards, or equipment. This assessment becomes part of the data base, and the resulting information is used in the next two steps.

c. Step 3. Develop the Manpower Concept

This step consists of two substeps.

(1) An analyst develops the installation schedule for the new Aviation E/S/S. This schedule provides the analyst with information on the number and types of platforms/activities on which the new E/S/S will be installed, and the number of units to be installed each fiscal year. Additionally, for new aircraft units, schedules are developed for the new aircraft unit stand-up and for predecessor unit phase-out. The analyst will also identify other manpower requirements from other commands and activities tasked to support the new E/S/S, such as manpower to support Development or Operational Test and Evaluation, Plant Representatives, and staff-level support.

(2) The analyst prepares the Manpower input to the MPTCD. See Appendix 1 for MPTCD format. This document is used as input to Step 4.

d. Step 4. Develop Manpower Resource Requirements

(1) In this step, total Coast Guard-wide Manpower resource requirements are determined and displayed by location (installation, maintenance, and training) and by fiscal year.

(2) For new aircraft acquisitions, total Coast Guard-wide resource requirements are developed, first on an aviation-unit level and displayed by fiscal year. Additional Manpower requirements generated as a result of the aggregation of aircraft into aviation units are also addressed.

(3) Data developed in this step are summarized into a volume called the MPT Resource Requirements Document. The format for the MPTRRD is a series of summary worksheets that roll up the different categories of manpower resource requirements by fiscal year, with short narratives to describe the various categories.

e. Step 5. Develop Program Documentation Input

This step is the same as step 5 in paragraph 5.4.2.3.1 E/S/S Application.

5.4.2.3.3 Total Vessel Application. This application of the MAPTIDES Methodology differs considerably from the other applications. The Total Vessel Application requires the analyst to take into account manpower cross-utilization, habitability constraints, non-hardware-based manpower requirements (such as watch stations and organizational support), and the impact of multiple E/S/S configurations. This application should also make maximum use of existing automated data systems (i.e., models) to determine Manpower domain requirements.

Despite these differences, the Total Vessel Application utilizes the same analytical principles and techniques, and produces data comparable to the other MAPTIDES applications. Because Total Vessel Acquisition programs often involve procurement of multiple new hardware components, this application is designed to draw on the Aviation and E/S/S Applications when those components are present on new vessels.

The Total Vessel Application is composed of the following five action steps that together provide a structured approach to Manpower planning and analysis for vessels. See Exhibit D-26 for an overview of the methodology.

a. Step 1. Collect Preliminary Total Vessel Data

(1) This step requires the analyst to collect and analyze preliminary program data on the new vessel, including mission constraints, performance goals, and planned equipment.

(2) Based on data collected, the analyst will develop a description of the total vessel Manpower requirements and initial vessel concept summaries.

b. Step 2. Conduct Manpower Engineering Study

Step 2 has four substeps to determine the likelihood of the new vessel meeting its mission requirements and its Manpower supportability.

(1) Using the new vessel's equipment and mission, the analyst will describe a notional vessel that will be used to select a Baseline Comparison Model. The BCM will be a complete vessel (consisting of the predecessor, if there is one, and other systems similar to the new vessel), and it will be made up of systems and equipment that have established and validated Manpower data approximating the requirements and constraints of the new vessel.

(2) The analyst may use the BCM equipment list to formulate inputs to the Navy Enhanced Manpower Determination Model (EMDM) or may contract to have this information developed. When the Navy model is

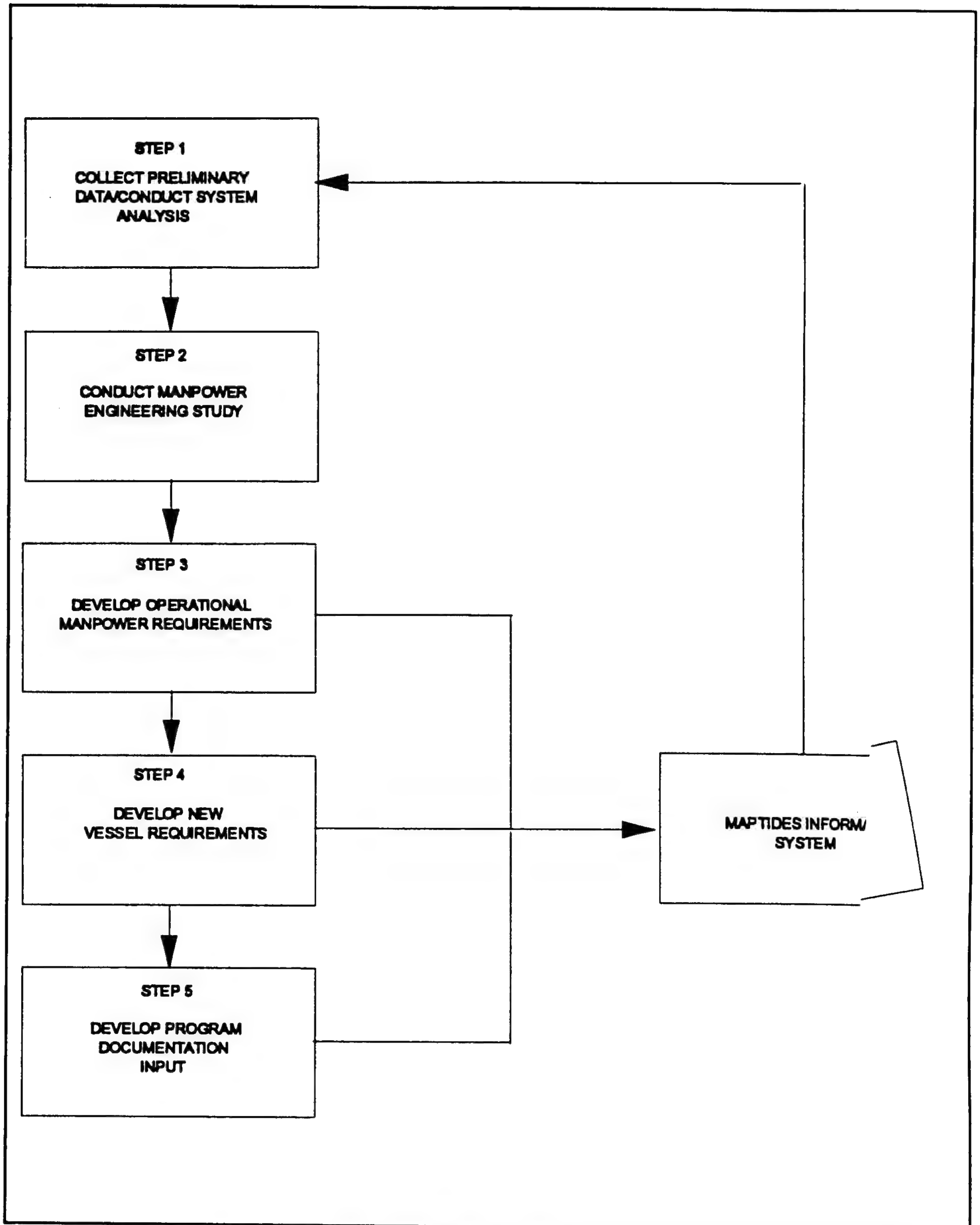



**Exhibit D-26. Total Vessel MANTIDES MPT Requirements Determination Methodology**

used, it is a computerized manpower estimation system consisting of a series of modules (i.e., work centers) that describe the new vessel. The EMDM takes cross-utilization of manpower into account to fully utilize all available man-hours.

(3) An initial estimate of manpower requirements from the model or a contractor will be used to conduct a crew size feasibility analysis. This study will be designed to determine whether the crew can be accommodated and supported by the proposed vessel design. For example, the estimated crew for the new vessel may be 65 billets, but the designers may have only provided space for 40 people. In this case, the crew size is clearly not practical; either the design of the vessel or its proposed capabilities must be changed.

(4) Based on iterations of manpower runs in the EMDM or similar information from a contractor, the analyst will prepare a Preliminary Manpower Report. The following format will be used.

(a) Introduction. Since several iterations of the PMR may be produced before the Preliminary Vessel Manpower Document is finalized, the introduction should indicate in what phase of the acquisition process this particular PMR was completed.

(b) New Vessel Description. This is a narrative describing major features, equipment, and capabilities of the new vessel that drive manpower. If BCM equipment is used, it should be clearly labeled. The analyst should also note that not all billets are driven by equipment. The following sub-elements are included:

1 New vessel description

2 Mission

3 Requirements/constraints

4 Known new vessel equipment

(c) New Vessel Manpower Requirements. This section will involve a brief narrative of the new vessel's manpower concepts and a list of manpower estimates.

(d) Equipment Options. This is a narrative explanation of probable equipment options and their impact on manning, including quantity and quality, if possible.

(e) Conclusion. The analyst will summarize the manpower requirements of the new vessel and discuss any other relevant factors concerning manpower associated with the new vessel.

(f) Appendices. The analyst will provide the following appendices and any other information relevant to the report that does not fit in the main body of the document.

1 Point of Contact List

2 Initial Estimate of Manpower (used to run the EMDM)

3 A discussion of crew size feasibility

c. Step 3. Determine Operational Manpower Requirements

(1) The Preliminary Vessel Manpower Document is developed during this step. The PVMD displays the manpower requirements for a single new vessel. This information is then multiplied by the new vessel delivery schedule to produce the manpower requirements of the entire new vessel class.

(2) Developing the PVMD requires determination of workload requirements. This may be done through the Navy Manpower Requirements System Model or by contractor. If the Navy model is used, the analyst develops workload-related input requirements and forwards them to the Navy for running the model. Workload is broken into the following five categories:

(a) Planned Maintenance (PLM). PLM is work accomplished in response to scheduled requirements. It is the total workload associated with the performance of maintenance actions on operational systems, equipment, or components.

(b) Corrective Maintenance (CM). CM is work accomplished on an unscheduled basis because of malfunction, failure, or deterioration. It is the workload associated with restoration of disabled systems, equipment, or components to an operational condition.

(c) Facility Maintenance (FM). FM consists of maintaining the cleanliness and sanitation of all habitable areas and preserving the hull, decks, superstructure, and equipment against corrosion and deterioration.

(d) Own Unit Support (OUS). OUS consists of the manpower required to provide administrative, command, supply, medical, utility task, and special evolution support.

(e) Watch Station Requirements (WSR). WSR consists of the manpower needed for essential operating stations as directed by the Required Operational Capability (ROC) during a specific condition of readiness with system scenario defined by its Projected Operating Environment (POE). WSR is also sometimes referred to as operational manning (OM).

(3) If the NMRS model is used, the analyst will provide workload-related data and the Navy will produce the manpower portion of the PVMD. The analyst will then add a foreword consisting of the following:

(a) Introduction

(b) POE

(c) ROC Statement

(d) Definition of Terms

See Appendix J for the PVMD format.

d. Step 4. Develop New Ship Training Requirements

In this step, the analyst will develop the training requirements of the new vessel and produce a draft CGTP using manpower estimates as a starting point.

e. Step 5. Develop Program Documentation Input

This step is the same as Step 5 of the E/S/S Application, paragraph 5.4.2.3.1.

5.4.3 Personnel Domain. Personnel refers to the people required to fill authorized billets and positions, both quantity and quality. Personnel includes the military and civilians with the aptitudes, skill levels, experience, and other human physical and mental characteristics needed to operate, maintain, and support Coast Guard equipment, vessels, and aircraft. This domain requires detailed assessment of the aptitudes, mental groups, and experience that personnel must possess to complete training and successfully use, operate, and maintain the system.

a. New systems must be configured specifically to accommodate the forecast capabilities of personnel projected to be available when the system is fielded; this

is one of the criteria for determining that the new system is supportable from a personnel standpoint.

Personnel analysis must consider not only simple availability, but also the capability of the Coast Guard personnel system to provide the needed numbers of properly qualified people, at a reasonable cost, and in the time frame required. Personnel should be included in system life-cycle cost estimates and system design trade-offs, i.e., machine costs versus personnel costs. Personnel analyses and projections are needed in time to allow orderly recruitment, training, and assignment of personnel in conjunction with equipment fielding.

b. Personnel planning during systems acquisition is the process of acquiring the human resources necessary to support identified manpower requirements. It involves procurement, classification, development, and utilization of personnel. Put simply, it is the function of "matching faces to spaces." The Personnel Management System is depicted in Exhibit D-27.

The personnel community has two major roles to play in the acquisition process. One role is in establishing and maintaining a classification system; this includes developing and managing career fields. Classification is based on an analysis of tasks necessary to support the new system. A comparison of those tasks to existing Coast Guard personnel standards will determine the occupational specialty, paygrade, and special skill requirements. This should confirm the manpower quality determined in the Initial Estimate of Manpower using the Baseline Comparison System. Any differences should be resolved in favor of the quality determined by the personnel system (or change the personnel standards).

The second role of the personnel community during the acquisition process is to plan for, recruit, classify, assign, and manage the people necessary to operate, maintain, and support the new system. An important function of personnel planning is the development of a projected force structure designed by grade, occupational specialty, and years of service. The projected force structure represents an integration of billet authorizations and of personnel policies necessary for effective and efficient force management.

The supportability assessment portion of the MAPTIDES Program enables the Coast Guard to engage in systematic trade-off analysis of system alternatives. Supportability data allows Coast Guard decision makers to view manpower requirements and personnel resources in aggregate form and use this combined data to assess development options. Similarly, aggregated data of Coast Guard personnel resources and requirements helps the Coast Guard make maximum use of its available personnel by tailoring its system-wide inventory to its manpower resource base.

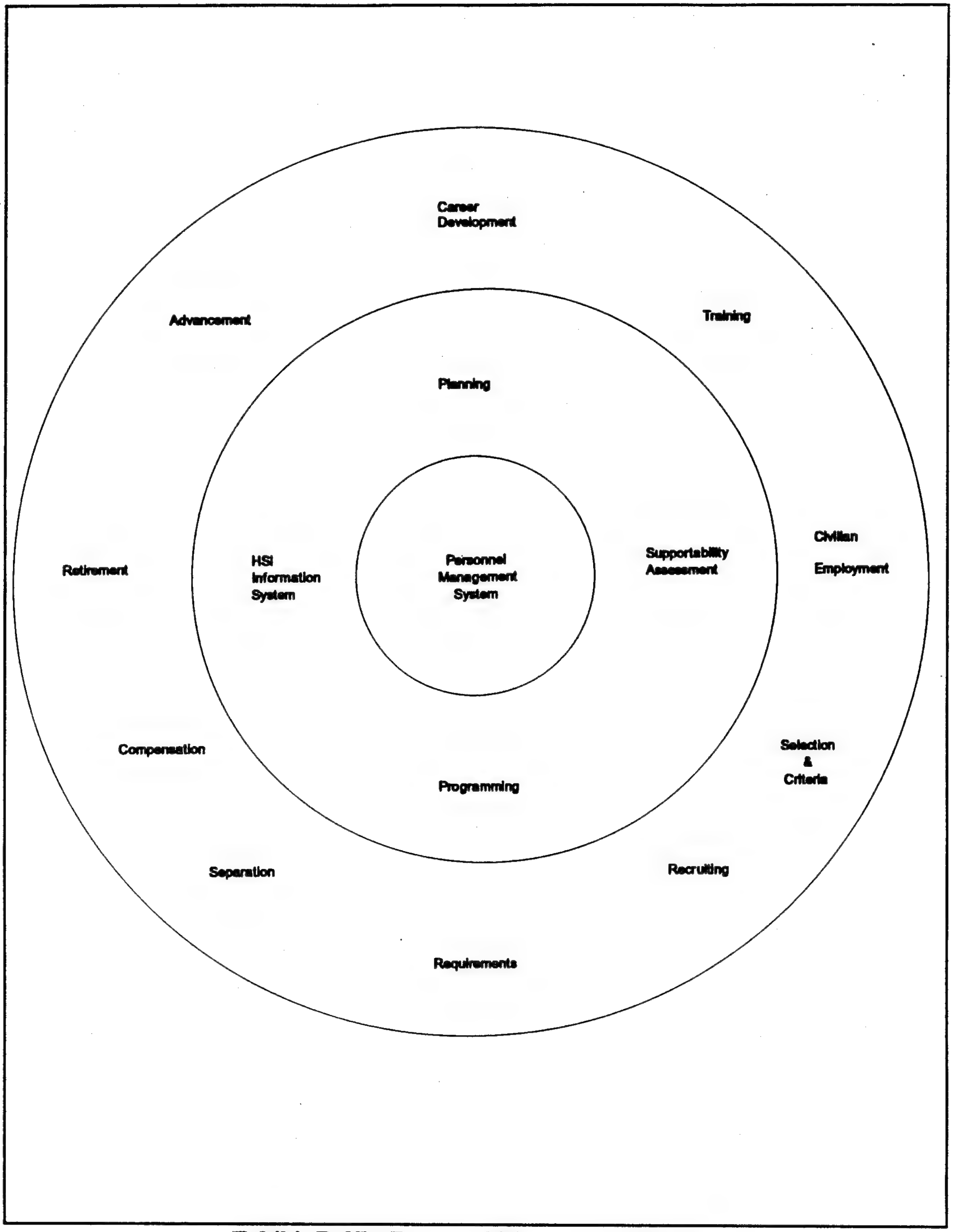



**Exhibit D-27. Personnel Management System**

It is crucial that the Coast Guard maintain a complete, functional Personnel management system. An important point, shown by Exhibit D-27, is that no overall personnel management system exists until a module or subsystem is operating for each of the functional personnel areas and all are linked together. In this way, the Coast Guard has the capability to match personnel and job — skill with requirement.

Personnel availability in subsequent years depends on the actual manpower distribution and the existing personnel policies (e.g., career paths and training course availability), which may be explicitly formulated or that may exist implicitly. Furthermore, personnel availability also depends on external variables, such as the size of the available labor force and the labor market. The values of these variables determine personnel availability, that is, the number and qualification of personnel expected to be available to the Coast Guard in future years.

The personnel community needs to know the detailed manpower requirements for new systems as early as possible in the acquisition cycle to effectively provide Personnel planning. Manpower and Personnel are complementary disciplines and their effective and efficient interaction in the acquisition process, as supported by the HSI Program, will enhance system supportability while contributing to a stable and productive force structure.

5.4.3.1 Personnel Analyses Required. The Personnel Domain requires iterative analyses as an integral part of the new system design process, starting early in the Project Initiation Phase.

a. By selecting a Baseline Comparison System as an initial step (and before conducting a complete BCS analysis), the known personnel requirements of the old system can be used to make a rough initial estimate of requirements for the new system (i.e., the personnel quality associated with the IEM, including occupational specialty, paygrade, and qualification code requirements). See Appendix H for IEM format.

b. When the IEM is determined, development of a Target Audience Description is initiated based on the military occupations, officer specialties, and similar civilian career fields/pay plans required for the new procurement. The TAD delineates the quantity and quality of active and reserve military, civil servants, and contractors who will most likely operate, maintain, and support the new procurement. This document describes the range of individual qualifications in all relevant physical, mental, physiological, biographical, and motivational dimensions. This information is included in system hardware/software requests for proposals, and the selected contractor(s) are held accountable for designing the system to these human specifications. The TAD is updated with each new

update of the IEM. Format for the Personnel portion of the TAD includes the following:

(1) Educational profiles

(2) Reading grade levels

(3) AFQT mental profiles

(4) Aptitude profiles

(5) Anthropometric data

(6) Physical qualifications

(7) Biographic information on civilian education, gender mix, and percentage with English as a second language may also be included.

c. The Front-End Analysis commences as soon as practical after start of the Project Initation Phase. See Exhibit D-23 for a description of the tasks that form the basis for FEA. The Front-End Analysis calls for a complete side-by-side systems analysis of the BCS, and will develop initial HSI requirements, including personnel quality, objectives, constraints, trade-offs, risks, and cost drivers. The results of the analysis will be used to provide inputs to the major program documentation.

d. Analysis of each system design alternative considered is required to determine the Personnel requirements of each to be used in the concept selection decision. The objective from a Personnel Domain perspective is to evaluate each alternative on the basis of how difficult that alternative will be for the Personnel system to execute in meeting the manpower (i.e., billet/position) requirements and how much impact that alterative will have on the Personnel system's ability to man the remaining Coast Guard manpower requirements in these same skills. For each alterative, the evaluation should include relative requirements for numbers of personnel, education level, experience (i.e., pay grade), mental group requirements, etc. This analysis should be presented at Key Decision Point Two in sufficient detail to describe the Personnel Domain impact in each concept alternative, including relative prioritization of the alternatives from the Personnel perspective.

e. The MAPTIDES Methodology commences with data collection at the same time as the Front-End Analysis. See Exhibit D-24 for a description of the MAPTIDES Methodology and refer to paragraph 5.4.2.1.e. for additional discussion of MAPTIDES.

5.4.3.2 MAPTIDES Documentation. The MAPTIDES Methodology continues through the five-action-step process during the Concepts Exploration and Demonstration/Validation Phases (including updates in the remaining phases) to produce the following Personnel domain documentation.

a. For Aviation and E/S/S procurements, the following documentation is developed that requires Personnel input:

(1) MPT Concept Document (MPTCD) — This document contains personnel quality associated with the manpower and maintenance concepts derived from the qualitative Personnel resource requirements (i.e., quality of required operators, maintainers, and other non-training personnel considerations) for each configuration of the new system. See Appendix I for format.

The level of detail presented should be consistent with the level of development of the new equipment. For example, at program initiation for new technology, it may only be appropriate to identify ratings; at KDP-2, however, it should be possible to identify ratings, paygrades, and qualification codes.

The following products are developed in producing the MPTCD:

(a) Installation Schedule

(b) Transitioning Unit Stand-Up, Phase-Out Schedule

(c) Other Personnel Requirements

(2) MPT Resource Requirements Document (MPTRRD) — This document details the aggregate quantitative and qualitative billets/positions and costs that the Manpower concept drives. Personnel inventory constraints and limitations are considerations integral to development of the manpower requirements for a new acquisition. For example, if the new system requires an enlisted rating or special qualification that is not currently available in the Coast Guard inventory, the Office of P should develop a plan for establishing the new rating/special qualification or should propose other alternatives for meeting the requirement. The plan should include all the necessary elements to support and sustain the new skill, including the timeframe when the skill is expected to be available to the Coast Guard. The Personnel plan should be developed, approved, and included in the manpower concept and cost requirements.

(3) Preliminary Aircraft Manpower Document (PAMD) — This document is prepared for aircraft procurements only. It is a statement of quantity and quality of total manpower required to support the entire buy of aircraft by fiscal year, including flight crews, administrative support, and maintenance support at the organizational, intermediate, and depot level depending on the maintenance concept. Even though the PAMD is a manpower document, the billet quality requirement should be adjusted as required to accommodate the quality of the personnel inventory expected to be available to the Coast Guard when the new system is fielded. The manpower analyst should start with the Personnel descriptions of existing and anticipated enlisted ratings, special qualifications, and both officer specialties and civilian career fields. These descriptions should include aptitude, mental group, education level, etc. required for each category of personnel. The analyst should use this information in establishing the manpower requirements for the new system.

b. In vessel acquisitions, the following documentation is developed that requires Personnel input:

(1) Preliminary Manpower Report — This report will update the IEM and contains a description of the new vessel, an explanation and justification of the Baseline Comparison Model, an estimate of new vessel personnel quality requirements, and program trade-offs (i.e., equipment options for the new vessel). The IEW will be in the format described in Appendix H, while the format for the PMR is included at paragraph 5.4.2.3.3.b.(4).

(2) Preliminary Vessel Manpower Document — The PVMD can be developed using the Navy NMRS Model or by contractor. As with similar Aviation and E/S/S Manpower documents, Personnel quality and support limitations and constraints are primary considerations in developing the PVMD.

5.4.3.3 <u>MAPTIDES Methodology for Determining Personnel Domain Requirements</u>. Analyses of Personnel requirements are completed in each of two different applications of the MAPTIDES Methodology (see Exhibit D-24).

a. Both Aviation and E/S/S procurements share the same application of the methodology.

b. Total Vessel acquisitions use a distinctly different application.

5.4.3.3.1 <u>E/S/S Application</u>. This application is used for all procurements acquired through the Coast Guard acquisition process, except for aviation and vessel procurements. Refer to Exhibit D-25 for the specific steps included in this application.

a. Step 1. Collect Preliminary Data/Conduct Systems Analysis

(1) Data is collected and reviewed by the analyst on the new E/S/S requirements, concepts, functions, performance goals, performance standards, and equipment.

(2) A systems analysis is performed to select a BCS. The BCS will be based either on the predecessor system or a group of comparable existing systems that best match the new system quality requirements, concepts, performance standards, and equipment. Personnel quality requirements data are collected on the platform/activities where the BCS is installed.

(3) Step 1 initiates development of the application's data base and audit trail used to track the design effort throughout the remainder of the project.

b. Step 2. Conduct Comparability Analysis

(1) This step consists of a series of procedures to assess differences in resource requirements between the BCS and the new system. This is done by comparing known parameters of the BCS with characteristics and performance standards of the new E/S/S.

(2) A comparison is done of both operator and maintainer functional tasks between the BCS and new E/S/S. This comparability analysis traces the source of resource changes to differences in requirements, concepts, performance standards, and equipment.

(3) Estimates of key Personnel data elements for new systems are determined from comparable BCS values through the formulation of deltas. A delta is the estimated change in BCS values dictated by design, operational, and functional changes in the new system. See Appendix K for a discussion of how to determine deltas.

c. Step 3. Develop the Personnel Concept

This step consists of three substeps and results in development of the Personnel input to the MPT Concept Document.

(1) The configuration(s) and the installation schedule for the new E/S/S are developed. This provides the analyst with the number and types of platforms/activities where the new E/S/S will be installed, as well as the number of installations by fiscal year. This information is available from the Program Sponsor and will be included in the MNS and AP.

(2) The Personnel quality portion of the MPT Concept Document is derived from the qualitative resource requirements for each unique E/S/S configuration. These requirements are grouped into three categories:

(a) Maintenance personnel

(b) Operator personnel

(c) Other non-training personnel

(3) The Personnel portion of the MPT Concept Document is prepared by the analyst using data from the previous two substeps. See Appendix I for MPTCD format. This concept document provides basic input to the MPT Resource Requirements Document.

d. Step 4. Develop Manpower, Personnel, and Training Resource Requirements Document. In Step 3, the Personnel quality portion of the MPT concept for operating, maintaining, and supporting a single E/S/S configuration was determined. In Step 4, Coast Guard-wide Personnel resource requirements are determined and displayed by location and by fiscal year.

e. Step 5. Develop Program Documentation Input

(1) The MAPTIDES Methodology is a structured and systematic means of addressing the many Personnel issues in the Coast Guard acquisition process. One principal value of this methodology is that it produces a single data source to be used by the OHSIP to meet all Personnel documentation requirements, thus ensuring consistency and comparability.

(2) Personnel quality inputs are required in all major program documentation and should be updated prior to each Key Decision Point.

5.4.3.3.2 Aviation Application. This application is similar to the E/S/S application. See Exhibit D-25 for the basic steps involved. It describes the procedures for applying the MAPTIDES Methodology to determine Personnel requirements for aircraft and Aviation E/S/S acquisitions. The aviation application is composed of the following five steps that together provide a structure for Personnel planning, analysis, and documentation during the Coast Guard acquisition process.

a. Step 1. Collect Preliminary Data and Conduct Systems Analysis

This step consists of two substeps. The analyst performs the following actions:

(1) Collects and reviews data on new Aviation E/S/S requirements, concepts, functions, performance goals, performance standards, and equipment

(2) Conducts systems analysis aimed at identifying a suitable BCS.

Data from this step are used to initiate development of the application's data base and audit trail. This data is also used in Step 2.

b. Step 2. Conduct Comparability Analysis

This step compares known parameters of the BCS with those of the new Aviation E/S/S collected in Step 1. The objective is to quantify resource differences between the two E/S/S. This is accomplished by comparing functional tasks (both operator and maintainer) of the BCS with the new E/S/S. This procedure will trace the source of resource changes to differences in requirements, concepts, performance standards, or equipment. This assessment becomes part of the data base, and the resulting information is used in the next two steps.

c. Step 3. Develop the Personnel Quality Portion of the MPT Concept Document

This step consists of two substeps.

(1) An analyst develops the installation schedule for the new Aviation E/S/S. This schedule provides the analyst with information on the number and types of platforms/activities on which the new E/S/S will be installed, and the number of units to be installed each fiscal year. Additionally, for new aircraft and aviation units, schedules are developed for new unit stand-up and predecessor unit phase-out. The analyst will also identify other personnel requirements from other commands and activities tasked to support the new E/S/S, such as support for Development or Operational Test and Evaluation, Plant Representatives, or staff level support.

(2) The analyst prepares an MPT Concept Document. See Appendix I for MPTCD format. This document is used as input to Step 4.

d. Step 4. Develop Personnel Resource Requirements

(1) In this step, total Coast Guard-wide Personnel resource requirements are determined, which is displayed by location (installation, maintenance, and training) and by fiscal year.

(2) For new aircraft acquisitions, total Coast Guard-wide resource requirements are developed, first on an aviation-unit level and displayed

by fiscal year. Additional Personnel requirements generated as a result of the aggregation of aircraft into aviation units are addressed.

(3) Data developed in this step is summarized into a volume called the MPT Resource Requirements Document. The format for the MPTRRD is a series of summary worksheets that roll up the different categories of Personnel resource requirements by fiscal year, with short narratives to describe the various categories.

e. Step 5. Develop Program Documentation Input

This step is the same as step 5 in paragraph 5.4.3.3.1 E/S/S Application.

5.4.3.3.3 Total Vessel Application. This MAPTIDES Methodology differs considerably from the other applications. The Total Vessel Application requires the analyst to take into account personnel cross-utilization, habitability constraints, non-hardware-based personnel requirements (such as watch stations and organizational support), and the impact of multiple E/S/S configurations. This application should make maximum use of existing automated data systems (i.e., models) to determine Personnel Domain requirements.

Despite these differences, the Total Vessel Application utilizes the same analytical principles and techniques, and it produces data comparable to the other MAPTIDES applications. Because Total Vessel Acquisition programs often involve procurement of multiple new hardware components, this application is designed to draw on the Aviation and E/S/S Applications when those components are present on new vessels.

The Total Vessel Application is composed of the following five action steps that together provide a structured approach to Personnel planning and analysis for vessels. See Exhibit D-26 for the steps involved in this application.

a. Step 1. Collect Preliminary Total Vessel Data

(1) This step requires the analyst to collect and analyze preliminary program data on the new vessel, including mission constraints, performance goals, and planned equipment.

(2) Based on data collected, the analyst will develop a description of the total vessel Personnel requirements and initial vessel concept summaries.

b. Step 2. Conduct Manpower Engineering Study

Step 2 has three substeps to determine the likelihood of the new vessel meeting its mission requirements and its Personnel supportability.

(1) Using the new vessel's equipment and mission, the analyst will describe a notional vessel that will be used to select a Baseline Comparison Model. The BCM will be a complete vessel (consisting of the predecessor, if there is one, and other systems similar to the new vessel), and it will be made up of systems and equipment that have established and validated Personnel data approximating the requirements and constraints of the new vessel.

(2) The analyst will use the BCM equipment list to formulate inputs either to the Navy Enhanced Manpower Determination Model (EMDM) or to a contractor. When the Navy model is used, it is a computerized personnel quality estimation system consisting of a series of modules (i.e., work centers) that describe the new vessel. The model takes cross-utilization of personnel into account to fully utilize all available man-hours.

(3) Based on iterations of runs from the model, or inputs from a contractor, the analyst will prepare a Preliminary Manpower Report, including Personnel quality. See paragraph 5.4.2.3.3.b.(4) for format.

c. Step 3. Determine Operational Manpower Requirements

(1) The Preliminary Vessel Manpower Document will be developed by the Manpower analyst, including Personnel quality, for a single new vessel. This information is then multiplied by the new vessel delivery schedule to produce the Manpower and Personnel requirements of the entire new vessel class.

(2) Developing the PVMD requires determination of workload requirements. This may be done through the Navy Manpower Requirements System Model or by contractor. If the Navy model is used, the analyst develops workload-related input requirements and forwards them to the Navy to run the model. See Section 5.4.2.3.3.c.(2) for an explanation of the five workload categories.

d. Step 4. Develop New Ship Training Requirements — In this step, the analyst will develop the training requirements of the new vessel and produce a draft CGTP. See paragraph 5.4.4 for a discussion of the Training Domain requirements.

e. Step 5. Develop Program Documentation Input — This step is the same as Step 5 of the E/S/S Application, paragraph 5.4.3.3.1.

5.4.4 Training Domain. Training consists of the instruction, time, and other resources necessary to impart the requisite knowledge, skills, and abilities to qualify personnel for operation, maintenance, and support of Coast Guard equipment. Training strategy includes the following:

a. Who is to be trained (i.e., active component, reserve, civilian)?

b. What is to be taught (i.e., system-specific tasks and operationally critical tasks)?

c. When is the training to take place (i.e., basic training, advanced individual training, and rate training)?

d. Where is the training to take place (i.e., institution — Coast Guard, other military service, contractor school — or at the unit level)?

Training concepts answer the question "how?" the training should be conducted (e.g., on the actual equipment, embedded training, training devices, or simulators). Sustainment training to maintain readiness levels must be considered, and it requires data on anticipated skill decay rates and resource constraints (including time) at the unit level. Training concepts include the following considerations:

a. Formulation and documentation of training strategies to qualify system personnel in the most cost effective manner

b. Formulation and selection of engineering design alternatives that are supportable from a training perspective

c. Timely determination of resource requirements to enable the Coast Guard training system to support system fielding

d. Analyses that take into account the expected aptitude levels, previous training, the nature and complexity of knowledge and skills to be acquired, and the proficiency level to be attained and sustained. Identifying and, where possible, minimizing the requirements in these areas should be an important consideration in selecting engineering design alternatives

e. The training package for a new system should include:

    (1) A documented training program for individuals and units (including any provision for embedded training, training devices, and team training where appropriate)

    (2) The process of transmitting the new knowledge to the Coast Guard (through factory training, training of test personnel, and the evaluation of the new training itself)

    (3) The timely identification of the resource requirements to enable the Coast Guard training establishment to support system fielding

The increasing complexity of vessels, aircraft, and equipment, coupled with limited fiscal resources to meet increasing training costs, requires that the Coast Guard establish and maintain an effective and efficient training system.

Training planning is a continuous process that occurs throughout the development and operational life of the system. Training development follows the same course as the development of the system it will support. The training plan begins in the MAPTIDES analysis as the development of training concepts and requirements needed to support the conceptual system; the training plan evolves into a resource requirements statement and detailed plan of courses, student load, training devices, and materials necessary to support a now existing materiel system.

The MAPTIDES Methodology was designed to initiate the MPT planning process at the beginning of the acquisition. This allows for the production of training planning data starting in the Project Initiation Phase. By doing so, MAPTIDES makes possible the comparison of alternative training concepts and the early formulation of the training plan and training resource requirements. Once determined, this allows ample lead time to program for and acquire training resources to formulate and establish the training program and to train and assign personnel. Total training resource requirements to establish initial and follow-on training capability must be incorporated in the programming and budgeting process early during hardware development and made increasingly definitive as the system development progresses.

To ensure effective training support of the new acquisition, the continuous and substantive involvement of the training community is required. With the assistance of the MAPTIDES analysis, early conceptualization has two distinct advantages. First, it provides a continuous "real-time" picture of system-driven training requirements based on the most current system data available, and it provides this picture early enough to be used in trade-off decisions. Second, it provides planners with information to project gross long-range requirements and conduct long-range training supportability assessments.

The training planning should incorporate a totally unified approach. The identification of training equipment and training device requirements, as well as initiation of a systematic approach to training (to include the Instructional System Development (ISD) process), should begin in the Project Initiation Phase. Training requirements are developed in the MAPTIDES analysis and are identified and approved in the Coast Guard Training Plan.

The determination as whether to use the actual equipment, simulated equipment, or combinations of actual equipment and simulators and/or training devices is a judgmental process. Selection procedures should be employed that require several alternatives to be evaluated for each new training requirement. The evaluation of each alternative includes advantages and disadvantages with respect to life-cycle cost, training effectiveness, availability to support the equipment fleet introduction schedule, reliability, maintainability, energy and environmental impacts, and flexibility.

5.4.4.1 Training Analyses Required. The Training domain requires iterative analyses as an integral part of the new system design process, with Training analyses commencing in the Program Initiation Phase.

Training analyses can commence when the Baseline Comparison System has been selected. The first step is to identify current training requirements for the BCS. The following definitions apply:

a. Prerequisite Training includes initial skill training (such as Class "A" school, as well as appropriate Class "C" and some Class "F" schools) that is required before the principal course is entered.

b. Formal School is an established Government-run school at which formal training is conducted on a recurring basis.

c. Formal Training is the training accomplished by means of structured training actions.

d. Informal Training is training accomplished by actions for which structuring is not specifically planned before hand. It includes on-the-job training (OJT) and onboard training (OBT).

The manpower and personnel quality requirements chosen for the IEM are used to guide the Training analyst to appropriate numbers of students to be trained, as well as ratings and skill levels required. The following data is collected from the BCS:

a. Type of Training

   (1) Prerequisite

   (2) Formal School

   (3) Formal Training

   (4) Informal Training

b. Category of Training

   (1) O-Level Operator

   (2) O-Level Maintenance

   (3) I-Level Maintenance

(4) D-Level Maintenance

(5) Team

c. Type of Formal School

(1) Officer

(2) "A"

(3) "C"

(4) Other

d. The following course information is recorded:

(1) Course Title

(2) Qualification Code

(3) Course Identification Number

(4) Date of Latest Schedule

(5) Length

(6) Attrition

(7) Times Given Per Year

(8) Class Size

(9) Location

e. Type(s) of training resources applicable to courses is also recorded:

(1) Training Devices — Simulators and other devices especially designed or modified for training

(2) Technical Training Equipment — Actual equipment developed by the acquisition process for fleet/field use, but dedicated to training

(3) Training Equipment — Equipment used by the fleet/field, other than Technical Training Equipment, which is dedicated to training

(4) Other Training Material — Includes instructional literature, instructional aids, and instructional aids equipment

Note: If this equipment requires computer software dedicated for training it should be included in these definitions.

The Front-End Analysis commences as soon after start of the Project Initiation Phase as practical, and is based on a series of specific tasks. See Exhibit D-23 for a description of these tasks. The Front-End Analysis calls for a complete side-by-side systems analysis of the BCS, and the FEA will develop initial HSI requirements, including training limitations, objectives, trade-offs, risks, and cost drivers. The results of the analysis will be used to provide inputs to the major program documentation.

Analysis of each system design alternative considered is required to determine the Training requirements of each alternative to be used in the concept selection decision. From an HSI perspective (and there may be other considerations as well), the alternative should be selected that offers the best combination (i.e., best value to the Coast Guard) of high system performance, low human ability requirements (i.e., numbers of people, aptitudes, mental group, paygrade, and training burden), and low life-cycle costs.

The MAPTIDES Methodology commences with data collection at the same time as the Front-End Analysis. See Exhibit D-24 for a description of the three applications. All applications are conducted by the office responsible for the HSI Program. MAPTIDES and the FEA continue in parallel. While the FEA determines HSI constraints, objectives, etc., that will become inputs to the major program documentation, MAPTIDES provides the detailed procedures for conducting the BCS analysis (thereby also contributing to the development of information provided as inputs to major program documents) and the remaining processes necessary to determine life-cycle Training requirements for the new system.

5.4.4.2 MAPTIDES Documentation. The MAPTIDES Methodology continues through the five-action-step process during the Concepts Exploration and Demonstration/Validation Phases (including updates in the remaining phases) to produce the following Training documentation.

a. For Aviation and E/S/S Procurements, the following documentation is developed:

(1) MPT Concept Document (MPTCD) — This document contains the training concepts derived from the manpower requirements and includes the following:

(a) Training Objectives are broad statements about why the training is going to be conducted. The objectives are based on the new E/S/S operator and maintainer tasks and will be the basis for developing the overall training strategy.

(b) Preliminary Training Approaches are how the training will be conducted through the use of the following types of training:

1 Interservice Training is training currently being conducted by other services. Applicable interservice training is identified through commonality of a Training objective.

2 Team Training is training for a group within a single dedicated center (intragroup training) or for two or more dedicated centers working together (intergroup training).

3 Skill Progression Training provides the advanced knowledge, skills, and techniques necessary for an individual to operate and/or maintain the E/S/S. This will normally be a Class "C" or "F" school and may lead to award of a qualification code.

4 Factory Training is defined as training or instruction provided by a vendor or manufacturer on how to maintain and/or operate a specific piece of equipment. Training can be conducted at the factory, at a Coast Guard school, or aboard the unit. Factory Training is also known as Contractor Plant Services (CPS) and contract specialized training.

5 Industrial Training is also normally provided by a vendor. It is the training given to Coast Guard civilians so they may install or inspect the installation of the E/S/S.

(c) Training Data Development expands on the preliminary training approaches to include the following:

1 Training Location is determined for skill progression training that currently does not exist, for training that does exist to determine if an alternative site may be more appropriate, and for training that will be a modification of existing training to determine if the existing site or an alternative site is more appropriate.

2 Training Collocation is the use of the same location for more than one course. This can reduce requirements for training facilities and training support materials.

3 Training Integration is the use of one course to train students of one rating in both operational and maintenance functions of an E/S/S.

4 Training Support Materials include training devices, technical training equipment, training equipment, and other training material (training aids, training aid equipment, and instructional literature). The need for E/S/S-related training support materials for all training in the training path is identified.

(d) MPT Concept Training Path is a graphic training path that must be developed to show the sequence and course duration of initial skill prerequisite and skill progression training courses required of an E/S/S trainee.

(2) MPT Resource Requirements Document (MPTRRD) — This document details the aggregate training costs that the training concept drives. The MPTRRD includes the following Coast Guard-wide training resources and costs:

(a) Annual Training Input Requirements

(b) Required Training Devices, Technical Training Equipment, and Training Equipment by Fiscal Year

(c) Other Training Material by Fiscal Year and Cost

Both the MPTCD and MPTRRD are iterative processes. In fact, they are so dynamic that the documents should indicate the point in the acquisition process when they were prepared. The MPTCD and MPTRRD together are used to determine if a Coast Guard Training Plan is required; if so, these documents provide the inputs necessary to develop the Training Plan.

(3) Coast Guard Training Plan (CGTP) — Inputs to develop the CGTP are primarily found in the following MAPTIDES documentation: MPTCD, MPTRRD, and PAMD. The plan should be prepared by OHSIP and the Program Sponsor with technical assistance from G-PRF; it should be reviewed by the PM, appropriate offices in the Office of P, and the relevant Training Centers. The draft Training Plan should then be distributed to all concerned offices for comment. All inputs are reviewed by the OHSIP, Program Sponsor, and the Office of P to determine if sufficient issues have been raised to require a Training Plan Conference;

if so, the conference should be co-chaired by OHSIP and the Program Sponsor. When all issues are resolved, the Office of P should review and approve the CGTP for the new system. Once approved, the plan should be reviewed annually to accommodate any changes required and to ensure adequate training support for the life of the system. The content of the Coast Guard Training Plan includes the following:

Part 1 Training Program Data — Includes operational use, equipment description, maintenance concepts, manpower concepts, and training concepts.

Part 2 Billet and Personnel Requirements — Includes total annual billet inputs to support the installation and operation of the equipment.

Part 3 Training Requirements — Includes location, course length, types of training, and training concept. It also specifies start time of schedule for all training classes for the next 5 years.

Part 4 Training Logistics Support Requirements — Covers all of the material and data required to support the training environment and training equipment.

Part 5 Major Milestones — Shows all major program milestones, such as Key Decision Points, and all training milestones.

Part 6 Actions or Decisions Required — Outstanding agreements that have not been completed, further coordination required with a platform or system, etc.

Part 7 Points of Contact

b. For Vessel Procurements, the following training documentation is developed:

(1) Preliminary Vessel Manpower Document — Step 4.0 of the MAPTIDES Methodology for vessels is devoted to development of new vessel training requirements. Products of this step include the following:

(a) List of Required Courses

(b) Training Resource Requirements

(c) Training Manpower Requirements

(d) Draft Coast Guard Training Plan

(2) Coast Guard Training Plan -- Inputs to this plan are found in data developed for the PVMD, as well as other sources the analyst must use to generate required information. Other aspects of developing a CGTP for new vessels are the same as described for Aviation and E/S/S procurements. See paragraph 5.4.4.2.a.(3) for format.

5.4.4.3 <u>MAPTIDES Methodology for Determining Training Domain Requirements</u>. Analyses of Training requirements are completed in each of two different applications of the MAPTIDES Methodology (see Exhibit D-24).

a. Both Aviation and E/S/S procurements share the same application of the methodology.

b. Total Vessel acquisitions use a distinctly different application.

5.4.4.3.1 <u>E/S/S Application</u>. This application is used for all procurements acquired through the Coast Guard acquisition process, except for aviation E/S/S and vessel procurements. Refer to Exhibit D-25 for the steps used in this application.

a. Step 1. Collect Preliminary Data/Conduct Systems Analysis

(1) Data is collected and reviewed by the analyst on the new E/S/S requirements, concepts, functions, performance goals, performance standards, and equipment.

(2) A systems analysis is performed to select the most appropriate BCS. The BCS will be based either on the predecessor system or a group of comparable existing systems that best match the new system quality requirements, concepts, performance standards, and equipment. Training requirements data are collected on the platform/activities where the BCS is installed. See paragraph 5.4.4.1 for analyses performed on the BCS and the data captured.

(3) Step 1 initiates development of the application's data base and audit trail used to track the design effort throughout the remainder of the project.

b. Step 2. Conduct Comparability Analysis

(1) This step consists of a series of procedures to assess differences in resource requirements between the BCS and the new system. This is done by comparing known parameters of the BCS with characteristics and performance standards of the new E/S/S.

(2) A comparison is done of both operator and maintainer functional tasks between the BCS and new E/S/S. This comparability analysis traces the source of resource changes to differences in requirements, concepts, performance standards, and equipment.

(3) Estimates of key training data elements for new systems are determined from comparable BCS values through the formulation of deltas. A delta is the estimated change in BCS values dictated by design, operational, and functional changes in the new system. See Appendix K for a discussion of how to determine deltas.

c. Step 3. Develop the Training Concept

This step consists of three substeps and results in providing the Training input to development of the MPT Concept Document.

(1) The configuration(s) and the installation schedule for the new E/S/S are developed. This provides the analyst with the number and types of platforms/activities where the new E/S/S will be installed, as well as the number of installations by fiscal year. This information is available from the Program Sponsor and will be included in the MNS and AP.

(2) The Personnel quality portion of the manpower concept is derived from the qualitative resource requirements for each unique E/S/S configuration. This information becomes an input to developing the Training Plan.

(3) The Training concept is determined for each unique E/S/S configuration. Training concept elements include:

(a) Team training

(b) Initial (factory) training

(c) Skills progression training

(d) Training paths

(e) Training support materials concept

(4) An MPT Concept Document is prepared by the analyst using data from the previous three substeps. See Appendix I for MPTCD format. This concept document provides basic input to the MPT Resource Requirements Document.

d. Step 4. Develop Manpower, Personnel, and Training Resource Requirements Document.

(1) In Step 3, the Training concept for operating, maintaining, and supporting a single E/S/S configuration was determined. In Step 4, Coast Guard-wide training resource requirements are determined and displayed by location and by fiscal year.

(2) Training-associated manpower is also determined in this step. The format for the MPTRRD is a series of worksheets that roll up the different categories of Training resource requirements by fiscal year with short narratives to describe the various categories.

e. Step 5. Develop Program Documentation Input

(1) The MAPTIDES Methodology is a structured and systematic means of addressing the many Training domain issues in the Coast Guard acquisition process. One principal value of this methodology is that it produces a single data source to be used by the OHSIP to meet all training documentation requirements, thus ensuring consistency and comparability.

(2) Training inputs are required in all major program documentation and should be updated prior to each Key Decision Point.

(3) Support for Training planning — This section utilizes the MPTCD and the MPTRRD to conduct training planning for the operation and support of the new E/S/S. The new E/S/S-related training must not only impart the necessary knowledge and skill, it must also be scheduled so that the arrival of trained personnel coincides with equipment arrival. Training planning is conducted in four primary areas.

(a) First, the Coast Guard Training Plan is the most significant training document for the new E/S/S; it identifies tasks, skills, and necessary training courses.

(b) Second, Instructional System Development should be used to develop the curriculum necessary to impart the knowledge and skills required to meet the human performance objectives of the new E/S/S.

(c) Third, training device estimates should be made to be consistent between the CGTP and ISD.

(d) And fourth, new facility construction requirements are estimated to support Training for the new E/S/S.

5.4.4.3.2 Aviation Application. This application is similar to the E/S/S application. See Exhibit D-25 for the basic steps in this application. It describes the procedures for applying the MAPTIDES Methodology to determine Training requirements for aircraft and aviation E/S/S acquisitions. The aviation application is comprised of the following five steps that together provide a structure for training planning, analysis, and documentation during the Coast Guard acquisition process.

a. Step 1. Collect Preliminary Data and Conduct Systems Analysis

This step consists of three substeps. The analyst performs the following:

(1) Collects and reviews data on new Aviation E/S/S requirements, concepts, functions, performance goals, performance standards, and equipment.

(2) Conducts systems analysis aimed at identifying a suitable BCS.

(3) Collects existing Training requirements associated with the transitioning unit(s) and BCS elements. A transitioning unit is the organization that employs the predecessor aircraft and will receive the new aircraft.

Data from this step are used to initiate development of the application's data base and audit trail. This data is also used in Step 2.

b. Step 2. Conduct Comparability Analysis

This step compares known parameters of the BCS with those of the new E/S/S collected in Step 1. The objective is to quantify resource differences between the two E/S/S. This is accomplished by comparing functional tasks (both operator and maintainer) of the BCS with the new E/S/S. This procedure will trace the source of resource changes to differences in requirements, concepts, performance standards, or equipment. This assessment becomes part of the data base, and the resulting information is used in the next two steps.

c. Step 3. Develop the Training Concept

This step consists of four substeps.

(1) The analyst develops the installation schedule for the new E/S/S. This schedule provides information on the number and types of platforms/activities on which the new E/S/S will be installed, and the number of units to be installed each fiscal year. Additionally, for new

aircraft and the aviation unit, schedules are developed for new aircraft unit stand-up and predecessor squadron phase-out.

(2) If Navy training facilities are to be used, the analyst conducts an analysis of existing Fleet Replacement Squadron (FRS) training to coordinate changes required because of the new E/S/S. This analysis will estimate changes in training for FRS operators and maintainers (both organizational and intermediate levels). The analyst will also assess skill progression training needs and gather predecessor course information.

(3) Training concepts for each unique E/S/S configuration are determined by the analyst, including initial factory training, skills progression training, training paths, and training support materials concepts.

(4) The analyst prepares the Training Domain portion of the MPT Concept Document. See Appendix I for MPTCD format.

d. Step 4. Develop Training Resource Requirements

(1) In this step, total Coast Guard-wide training resource requirements are determined and displayed by location (installation, maintenance, and training) and by fiscal year.

(2) Costs associated with initial hardware and course development, and with initial training facilities development, are also determined by fiscal year.

(3) For new aircraft acquisitions, total Coast Guard-wide resource requirements are developed, first on an aviation-unit level and displayed by fiscal year. Additional Training requirements generated as a result of the aggregation of aircraft into aviation units are addressed.

(4) Data developed in this step are summarized into a volume called the MPT Resource Requirements Document. The format for the MPTRRD is a series of summary worksheets that roll up the different categories of Training resource requirements by fiscal year, with short narratives to describe the various categories.

e. Step 5. Develop Program Documentation Input

This step is the same as steps in paragraph 5.4.4.3.1 E/S/S Application.

5.4.4.3.3 <u>Total Vessel Application</u>. This application of the MAPTIDES Methodology differs considerably from the other applications. The Total Vessel Application requires the analyst to take into account cross-utilization, habitability constraints, non-hardware-based requirements

(such as watch stations and organizational support), and the impact of multiple E/S/S configurations.

Despite these differences, the Total Vessel Application utilizes the same analytical principles and techniques, and it produces data comparable to the other MAPTIDES applications. Because Total Vessel Acquisition programs often involve procurement of multiple new hardware components, this application is designed to draw on the Aviation and E/S/S Applications when those components are present on new vessels.

The Total Vessel Application is composed of the following five action steps that together provide a structured approach to training planning and analysis for vessels. See Exhibit D-26 for the steps in this application. Training is primarily involved with the BCS in Step 2 and all of Step 4.

a. Step 1. Collect Preliminary Total Vessel Data

   (1) This step requires the analyst to collect and analyze preliminary program data on the new vessel, including mission constraints, performance goals, and planned equipment.

   (2) Based on data collected, the analyst will develop a description of the total vessel Manpower and Personnel requirements and initial vessel concept summaries.

b. Step 2. Conduct Manpower Engineering Study

   (1) Step 2 determines the likelihood of the new vessel meeting its mission requirements and its training supportability.

   (2) Using the new vessel's equipment and mission, the analyst will describe a notional vessel that will be used to select a Baseline Comparison Model. The BCM will be a complete vessel (consisting of the predecessor, if there is one, and other systems similar to the new vessel). The BCM will be made up of systems and equipment that have established and validated training data approximating the requirements and constraints of the new vessel. Training data and the IEM based on the BCS will be used as a starting point for training analysis on the new vessel.

c. Step 3. Determine Operational Manpower Requirements

   The Preliminary Vessel Manpower Document is developed during this step. The manpower requirements are used to start the training analysis and CGTP.

d. Step 4. Develop New Ship Training Requirements

(1) In this step, the analyst will develop the Training requirements of the new vessel and produce a draft CGTP. The analyst will start by determining the training necessary, assessing the impact on existing training courses, listing the specific courses required, and determining the location. With this information, the Training support requirements can be determined.

(2) The last task in this step is to develop the CGTP. It will contain both the system manpower and the Training manpower requirements, as well as the required courses and the remaining Training resource requirements. The CGTP will also include the costs of all Training resource requirements. See paragraph 5.4.4.2.a.(3) for the CGTP format.

e. Step 5. Develop Program Documentation Input

This step is the same as Step 5 of the E/S/S Application, paragraph 5.4.4.3.1.

5.4.5 Primary Analytical Tools and Data Management Techniques. The three applications of the MAPTIDES Methodology use established analytic and management tools to determine MPT requirements. The major tools and their relationship to the MAPTIDES Methodology are discussed in the following paragraphs.

5.4.5.1 Comparability Analysis. The Military Standard on Logistics Support Analysis (MIL-STD-1388-1A) identifies comparability analysis as the preferred method for estimating key system elements during the early phases of the acquisition process. All applications of the MAPTIDES Methodology are designed to determine MPT resource requirements during the early phases of the acquisition process by using comparability analysis. Detailed data on system equipment and on key MPT data (e.g., tasks) are typically unavailable during the early phases of the acquisition process; direct estimates of this data are also typically unavailable during this time. Estimates of MPT resource requirements are difficult to make without such data. To avoid this problem, the MAPTIDES Methodology uses comparability analysis to estimate these key data items.

In the Aviation and E/S/S Applications, the MAPTIDES Methodology identifies and analyzes a predecessor system(s) and/or other comparable systems to produce a Baseline Comparison System to compare with the new E/S/S. In the Total Vessel Application, the methodology identifies and analyzes ship systems similar to those of the new vessel to produce a Baseline Comparison Model that serves as a benchmark in identifying MPT resources for the new vessel. The analyst extrapolates the known MPT data from the BCS or BCM to produce an estimate of the new vessel or E/S/S MPT data.

A predecessor system(s) is a system that is currently performing the mission(s) that will eventually be performed by the new acquisition; it is the system that will be replaced by the new procurement. By definition, a predecessor system(s) is a system currently in the Coast Guard

inventory. In some cases, where a new mission is created or where new technology is introduced, a predecessor system may not exist.

In cases where a predecessor system does not exist, or is not suitable for comparability analysis, a BCS/BCM is still produced. In these cases, the BCS/BCM is developed from comparable existing systems using Coast Guard/DoD/NATO/Civilian inventory that:

a. Best meet the mission, operational, configuration, and performance requirements of the new acquisition.

b. Have mature reliability/maintainability data or maintenance workload data and operator workload requirements base.

c. Have the organization and support concepts that most closely match those of the new procurement.

There may be more than one comparable system. In these cases, the "best" comparable existing system is selected. In many instances, the predecessor system will be the only system that comprises the BCS/BCM. In cases where the new acquisition assumes the mission of the predecessor (e.g., a missile system replacing a gun system), there may be no relationship between the BCS/BCM and the predecessor system.

Compatibility analysis allows the analyst to use MPT data elements from the BCS/BCM to estimate comparable data for the new procurement. It modifies existing data to reflect differences from the BCS/BCM and the new acquisition and incorporates new technologies and design differences into MPT requirements for the new procurements. During the later phases of the acquisition process, MPT data elements may be supplied directly by the contractor(s) or by cognizant Government agencies.

Estimates of the key MPT data element values for the new acquisition are determined from comparable BCS/BCM values dictated by design, operational, and functional changes incorporated in the new procurement. Deltas are applied by the analyst to the appropriate data element value to produce corresponding values for the new acquisition's MPT data elements. A comprehensive discussion of methods for developing deltas is contained in Appendix K.

5.4.5.2 Application Data Base. Each new acquisition program establishes its own data base. The data base is designed to function as the sole repository for all manpower, personnel, and training information collected and developed throughout the conduct of each MAPTIDES application. This data base should be automated. The data base, which should be located within easy access of its primary developers (the analysts), will consist of worksheets, computer printouts, acquisition documents, etc. The organization and maintenance of the data base will depend in part on personal preferences, prevailing office policies, and upon availability of automated capabilities.

The various steps, substeps, and procedures that comprise each application of the MAPTIDES Methodology are designed to develop a complete and consolidated MPT data base. The steps/substeps and procedural structure of the MAPTIDES Methodology build the data base in a systematic and orderly fashion as information is collected. In addition, worksheets, which ultimately record data elements in the data base, provide an audit trail for tracking the development of each MPT data element of the new acquisition.

5.4.5.3 Audit Trail. The audit trail is a key part of the MAPTIDES Methodology. It provides the analyst with a way of checking and verifying the data. The audit trail is developed in two ways. The first aspect of the audit trail provides for tracking design, mission, and scenario differences between the BCS/BCM and the new procurement. These differences are the sources of deltas (changes), which are calculated during comparability analysis.

The second aspect of the audit trail is developed by utilization of audit trail spaces provided on each MAPTIDES worksheet. These spaces indicate "Data Transferred From, "Transfer Data To," "Source of Data/Date Prepared."

Use of these audit trail spaces will allow the analyst to trace the source and application of all data recorded on worksheets, backward and forward. This will be most helpful during review. In addition, the audit trail facilitates the ongoing application of the MAPTIDES Methodology when personnel changes occur among the staff performing the analysis.

5.4.6 Applicability. Exhibits D-28 through D-34 describe the MPT objectives, inputs used, products developed, and major tasks performed in each of the seven Coast Guard acquisition phases. Coupling these more technical activities with the HSI Program Management actions, discussed in paragraph 5.1, completes the MPT processes required to impact system design and determine life-cycle MPT requirements for the new acquisition.

# MANPOWER/PERSONNEL/TRAINING DOMAINS

**Objectives:**

- 1. Identify Baseline Comparison System (BCS) for Comparative Analysis
- 2. Develop Initial Estimate of Manpower (IEM) as input to Major System Acquisition Project Nomination Memorandum
- 3. Determine MPT objectives, constraints, performance criteria, trade-offs, risks, and cost drivers as inputs to major program documentation (e.g., MNS, PORD/ORD, AP, PMP, TEMP, ILSP) and hardware/software RFPs

INPUTS

- 1. Mission Requirements
- 2. Technology Assessment
- 3. MPT Lessons Learned

**Project Initiation Phase**

PRODUCTS

- 1. BCS
- 2. IEM
- 3. MPT objectives, constraints, performance criteria, trade-offs, risks, and cost drivers

**TASKS:** Initiate MAPTIDES Methodology, Front-End Analysis (FEA), and Target Audience Description (TAD)

- 1. Collect preliminary data on the new system, i.e., system requirements, concepts, functions, performance goals, performance standards, and equipment.
- 2. Conduct Systems Analysis to form a BCS -- The BCS will be one or a group of comparable existing systems (predecessor and others as required) that best match system requirements, concepts, functions, etc. of the new system.
- 3. Collect billet resource requirements from the BCS and conduct a rough comparison with the new system to develop the IEM.
- 4. Commence FEA by completing initial FEA tasks. Using the BCS parameters, lessons learned, and with mission/technology inputs on the new system from the Program Sponsor, commence developing MPT objectives, constraints, performance criteria, etc. for input to major program documents and RFPs.
- 5 Commence development of the Target Audience Description.
- 6. Commence Comparative Analysis -- By comparing known parameters of the BCS with functional requirements of the new system, determine MPT resource changes required for the new system, both operators and maintainers.

**Exhibit D-28 . MPT Domains in Project Initiation Phase**

# MANPOWER/PERSONNEL/TRAINING DOMAINS

**Objectives:**

- 1. Make meaningful inputs to Mission Need Statement, Preliminary Operational Requirements Document,and strategy objectives for the Acquisition Plan
- 2. Complete as much FEA as possible in this phase
- 3. Update IEM

INPUTS

- 1. Mission Functional Analysis
- 2. IEM
- 3. BCS
- 4. Draft TAD

***Requirements Definition Phase***

PRODUCTS

- 1. MPT objectives, constraints, performance criteria, trade-offs, risks, and cost drivers as inputs to MNS, PORD, and AP strategy objectives
- 2. Updated IEM
- 3. FEA (or Draft)
- 4. TAD

**TASKS:** Continue MAPTIDES Methodology, FEA, and TAD

- 1. Complete as much of the FEA as possible while developing MPT objectives, constraints, performance criteria, trade-offs, risks, and cost drivers.
- 2. Prepare specific MPT inputs in the appropriate formats for the MNS, PORD, strategy objectives for the AP, System Cost/Effectiveness Analysis, and KDP-1.
- 3. Continue MAPTIDES Comparative Analysis -- Estimates of key MPT data elements for the new system are determined from comparable BCS values through the formulation of deltas. A delta is the estimated change in BCS values dictated by design, operational, and functional changes in the new system. See Appendix K for a discussion on deltas.
- 4. Update IEM based on BCS Comparability Analysis.
- 5. Finalize TAD.
- 6. Initiate Training Analysis based on the IEM and update.

**Exhibit D-29 . MPT Domains in Requirements Definition Phase**

# *MANPOWER/PERSONNEL/TRAINING DOMAINS*

## Objectives:

- 1. Make meaningful MPT inputs to the PORD/ORD, AP, PMP, TEMP, ILSP, and RFPs
- 2. Complete any FEA remaining
- 3. Develop life-cycle MPT costing for each design alternative
- 4. Update IEM - produce Preliminary Manpower Report (PMR) for vessels

INPUTS

- 1. MNS
- 2. Updated IEM
- 3. Mission Functional Analysis Report
- 4. AP strategy objectives

***Concepts Exploration Phase***

PRODUCTS

- 1. Updated MPT objectives, constraints, performance criteria, tradeoffs, risks, and cost drivers for inputs to program documentation
- 2. Updated IEM and PMR (for vessels)
- 3. MPT Concept Document (for non-vessel acquisitions)
- 4. MPT Resource Requirements Document (for non-vessel acquisitions)

## TASKS: Continue MAPTIDES Methodology and complete any remaining FEA

- 1. Complete FEA tasks to finalize MPT objectives, constraints, etc.
- 2. Provide life-cycle cost for each design alternative.
- 3. Prepare specific inputs in appropriate formats for PORD/ORD, AP, PMP, TEMP, ILSP, RFPs, and make inputs as required to Feasability Studies, Trade-off Analyses, Project Baseline Document, and KDP-2.
- 4. Use MAPTIDES Methodology to develop MPTCD and MPTRRD for non-vessel acquisitions, and the PMR for vessels. This will also update the IEM for non-vessels.

Exhibit D-30. MPT Domains in Concepts Exploration Phase

## *MANPOWER/PERSONNEL/TRAINING DOMAINS*

**Objectives:**

- 1. Complete the MAPTIDES Methodology
- 2. Influence selection of system hardware/software contractor(s)
- 3. Provide inputs as required to system design, Risk Analysis, Trade-off Analysis, ADM Demonstration and Validation, and Test and Evaluation
- 4. Provide input to Equipment Facility Requirement (EFR) Plan (Phase I) developed by the ILS Manager

INPUTS

- 1. PORD/ORD
- 2. AP
- 3. PMP
- 4. TEMP
- 5. ILSP
- 6. Source Selection Criteria

***Demonstration/ Validation Phase***

PRODUCTS

- 1. PVMD for vessels, PAMD for aircraft
- 2. Draft Coast Guard Training Plan
- 3. Input to EFR Plan (Phase I)

**TASKS:** Complete MAPTIDES Methodology and Select System Hardware/Software Contractor(s)

- 1. Complete the prescribed steps in the MAPTIDES Methodology to develop the PVMD for vessels, PAMD for aircraft , and the draft Coast Guard Training Plan. Identify sources of manpower and coordinate review of Coast Guard Training Plan.
- 2. Influence source selection for hardware/software contractor(s) based on source selection criteria and HSI content of contractor proposals.
- 3. Define requirements for any new occupational specialities or high quality personnel.
- 4. Evaluate training system effectiveness.
- 5. Budget MPT life-cycle costs; provide MPT inputs to life-cycle costs.
- 6. Identify MPT Test and Evaluation requirements.
- 7. Provide HSI inputs to update all required program documentation, ILSP, Risk Assessment, and KDP-3.
- 8. Provide inputs to the EFR Plan (Phase I).

**Exhibit D-31 . MPT Domains in the Demonstration/Validation Phase**

# *MANPOWER/PERSONNEL/TRAINING DOMAINS*

## Objectives:

- 1. Update and get Coast Guard Training Plan approved
- 2. Refine and update manpower and training plans as necessary
- 3. Participate in operational test and evaluation

INPUTS

- 1. PVMD for vessels and PAMD for aircraft
- 2. Draft Coast Guard Training Plan
- 3. EFR Plan (Phase I)

***Full Scale Development Phase***

PRODUCTS

- 1. Updated CGTP
- 2. Inputs to EFR Plan (Phase II)

TASKS: Continue development and coordination of training and manpower plans - conduct T&E of system/subsystem design

- 1. Update CGTP; Determine if Training Plans Conference is necessary - if so, plan and conduct TPC; coordinate approval of CGTP.
- 2. Provide MPT inputs to update program documentation and procurement packages as required.
- 3. Program/budget training and manpower resources required.
- 4. Provide input to the EFR Plan (Phase II).
- 5. Update and refine any manpower and training plans required.
- 6. Office of P finalize Personnel Allowance Lists (PALs).

**Exhibit D-32 . MPT Domains in the Full Scale Development Phase**

## *MANPOWER/PERSONNEL/TRAINING DOMAINS*

**Objectives:**

- 1. Update CGTP as required
- 2. Correct problems found in T&E
- 3. Coordinate hand-off of personnel and support plans to activities providing life-cycle support

INPUTS

- 1. CGTP
- 2. EFR Plan (Phase II)

***Production Phase***

PRODUCTS

- 1. Input to the EFR Plan (Phase III)

**TASKS:** Refine and update any manpower or training plans as required

- 1. Review and update CGTP, PVMD for vessels, PAMD for aircraft, or other manpower and training documentation as necessary.
- 2. Provide input to the EFR Plan (Phase III).
- 3. Coordinate the hand-off of MPT plans to the Office of Personnel and Training representatives for life-cycle support of the new system.

**Exhibit D-33. MPT Domains in the Production Phase**

# *MANPOWER/PERSONNEL/TRAINING DOMAINS*

**Objectives:**

- 1. Finalize and turn over all MPT plans.
- 2. Provide MPT input to all final documentation
- 3. Capture all required MPT data for use in future acquisitions

INPUTS

- 1. CGTP

***Deployment Phase***

PRODUCTS

- 1. MPT Lessons Learned
- 2. MPT Data Bases

**TASKS:** Finalize all documentation and retain all appropriate records

- 1. Coordinate completion of MPT plans and documentation; complete final turnover to life-cycle support activities.
- 2. Provide MPT input to Project Transition Plan, ILS Effectiveness Assessment, and updates to ILSP and OLSP.
- 3. Develop MPT lessons learned and retain for future use.
- 4. Retain all MPT data bases for use as BCS in future acquisitions.

**Exhibit D-34 . MPT Domains in the Deployment Phase**

# SECTION E
# HSI IN ALTERNATE ACQUISITION STRATEGIES

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## LIST OF EXHIBITS

# SECTION E
# HSI IN ALTERNATE ACQUISITION STRATEGIES

The Coast Guard has traditionally used the full development Life-Cycle Model to develop and acquire new equipment. Declining resources and the associated need to field systems in the least possible time, however, make alternatives to full developmental programs increasingly attractive. Similarly, the streamlining and tailoring of the acquisition process, both for full development programs and alternative strategies, is a necessary part of efficient planning.

1. <u>SPECTRUM OF ACQUISITION STRATEGY</u>. Refer to Exhibit E-1 below. In developing acquisition strategy, planners should first consider improving or reconfiguring the existing materiel system (i.e., a materiel change), followed by use of the most appropriate form of Non-Developmental Item (NDI), and finally, development of a new system. All acquisition strategies should use appropriate tailoring to hold down costs while requiring enough analyses and data to make appropriate decisions. Acquisition alternatives can also include the use of commercial components and subsystems for integration into a new development system.

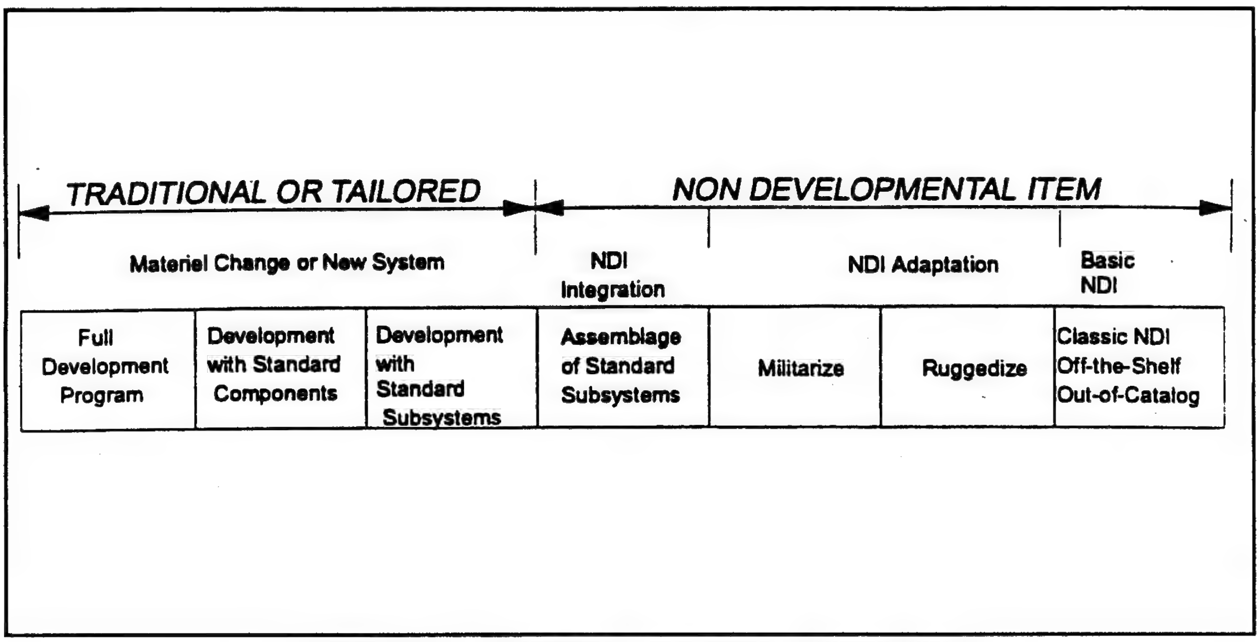


**Exhibit E-1. Available Acquisition Alternatives**

From a Human System Integration (HSI) perspective, the challenge in any acquisition alternative is the ability to influence system design. This ability requires early involvement in the procurement by the OHSIP regardless of the acquisition strategy (i.e., whether traditional, tailored, or NDI). For most of these alternative strategies, the time available to perform HSI analyses is significantly reduced compared to the traditional full development program. For NDI programs, system design may already be complete, and HSI may only serve as a means to discriminate between candidate systems (this is, however, an important role to ensure the new

NDI is compatible with the capabilities and limitations of the Coast Guardsmen that must operate, maintain, and support the equipment).

2. ADVANTAGES AND DISADVANTAGES OF ALTERNATIVE ACQUISITION STRATEGIES. Despite the reduced time expected for HSI analyses, alternative acquisition strategies offer significant advantages:

a. The time to field equipment is reduced, providing increased responsiveness to the field.

b. Research and development costs are reduced, thereby lowering overall acquisition costs.

c. State-of-the-art technology is utilized to satisfy user needs.

d. The mobilization base is expanded to include available commercial production facilities.

e. Available provisioning manuals and special tools can be used to reduce logistic support costs.

Along with these advantages, there are also areas of concern that must be considered:

a. The new system may not meet all user requirements.

b. Integrated Logistic Support (ILS) activities, normally accomplished in pre-production phases, must be accelerated increasing up-front costs.

c. Proliferation of hardware and software systems may result, causing logistics support, training, and configuration management problems.

d. Inherent safety deficiencies may pose unacceptable risks.

e. Program management documents, such as the Operational Requirements Document (ORD) and HSI System Management Plan (HSISMP), must be expedited for the shorter acquisition cycle.

f. Human Factors Engineering (HFE) issues may not be adequately addressed.

3. ACQUISITION ALTERNATIVES. Once the need for a materiel solution has been determined, the acquisition strategy selection starts with improvement or reconfiguration of the existing materiel system, followed by the use of NDI, and finally, the development of a new system. The HSI procedures used to support the traditional full development program are

applicable to all acquisition strategy alternatives. However, each strategy requires a tailored HSI approach, based on the complexity, cost, and schedule constraints of the program.

3.1 HSI in Materiel Change. Materiel change involves the modification or reconfiguration of a fielded system to provide new or improved capabilities, extend the system's useful life, improve safety or readiness, or reduce operation or support costs. In some cases, a materiel change may be required to correct a system's HSI deficiencies that have been documented in the HSISMP.

The materiel change program can range in complexity from the modification of a subsystem for safety or health reasons to major modifications which will expand the operational performance envelope and result in an essentially new system.

When evaluating the impact of a proposed materiel change, a total system perspective must be used so that implications from all five HSI domains can be adequately appraised. If an HSISMP for the system already exists, the HSI Joint Working Group's (HSIJWG's) materiel change assessment should be noted and appended to Tab G - Audit Trail (see Appendix E for HSISMP format).

When a proposed materiel change has HSI implications, a crosswalk of system performance information contained in key program documents is required. Supporting program documents should be modified to reflect HSI considerations. Once the materiel change proposal and support documentation have been staffed, the Configuration Control Board (CCB) will meet to consider the proposed change. Based on the information presented, the CCB should develop the technical recommendation and validate the decision level for the materiel change.

In-house or contractor requirements for modifications should include HSI constraints. Engineering Change Proposals (ECP) and Materiel Change Packages (MCP) should be reviewed to ensure that human performance problems, such as increased manpower requirements, additional skill requirements, or increased training times, are not unintentionally designed into the modified system.

Depending on the degree of the materiel change, testing will be required to ensure that the change is technically adequate and that it achieves the user's desired operational requirements. The need to assess a materiel change from an HSI perspective should be included in the system's Test and Evaluation Master Plan. The decision authority at Key Decision Points will review all data and either approve or disapprove the materiel change.

3.2 HSI in Evolutionary Acquisition (EA). EA provides the deferred insertion of emerging technologies in a new materiel system. EA programs complement near-term acquisitions by providing for parallel or phased development and future incorporation of added capabilities without increasing the near-term risk. These planned improvements, or "block mods," are programmed during basic system development.

EA requires pre-planning and up-front equipment design to allow for specific future upgrades. HSI implications should be addressed during the development of the primary system using the procedures described for the traditional acquisition strategy. However, since the definition of the final system is often not completed until late in the basic system development cycle, the HSIJWG must remain involved in the development throughout the acquisition and deployment process.

3.3 Non-Developmental Item Acquisitions. NDI procurements require little or no development effort by the Coast Guard. Normal sources of NDI materiel include commercial products (which may or may not require modification), materiel used by other U.S. military services or Government agencies, and materiel used by other countries. NDI acquisitions are preferred when a materiel change is not feasible and when the market analysis process demonstrates that commercial-off-the-shelf items are currently available that meet user needs.

Significant examples of NDI programs include the Army's modification of a Chevrolet Blazer to perform as its Commercial Utility Cargo Vehicle, Navy selection of an Israeli- developed short-range remotely piloted vehicle, and the Air Force adoption of a McDonnell Douglas passenger/freight aircraft to become the KC-10 tanker.

3.3.1 Types of NDI. A common misconception is that NDI and commercial-off-the-shelf equipment are synonymous. As shown in the Available Acquisition Alternatives (Exhibit E-1), there are three categories of NDI procurements, and the HSI applications will vary accordingly.

a. Basic NDI. Basic NDI procurement involves an off-the-shelf item (commercial, foreign, other service) that will be used in essentially the same application and environment for which it has been designed. For this category, since the design is not changed, HSI can serve as a means to discriminate between existing candidate systems.

b. NDI Adaption. An NDI Adaption procurement involves an off-the-shelf item (commercial, foreign, other service) that will be used in an application or environment other than that for which it has been designed. In this case, the item often requires ruggedization or militarization. Although these modifications constitute "design changes," the opportunity for hardware redesign as a result of HSI is usually minimal.

c. NDI Integration. This category of NDI refers to a procurement that makes maximum use of NDI items as subsystems, modules, or components in a low-risk system integration. This category requires a dedicated Research and Development (R&D) effort for systems engineering, modification, and testing to ensure that selected NDIs work together as an integrated system that meets the user requirements. In this category, there may be opportunities for HSI to make inputs to the system integration and design.

3.3.2 HSI in NDI Acquisitions. For NDI acquisitions, HSI must focus on the acceptability of using an existing or a slightly modified system. While NDI acquisitions are promising from a time, cost, and technology standpoint, they require flexibility by the user of the system and an early awareness of possible requirement trade-offs.

One of the major differences between NDI and the traditional full development program is emphasis on the market analysis process. Market analysis activities provide the information necessary to determine whether to pursue an NDI solution, and to evaluate the HSI implications of the candidate systems. Market analysis is conducted in two phases: market surveillance and market investigation.

Market surveillance establishes the feasibility of NDI as an acquisition strategy. Feasibility refers to the availability of commercial products with the potential to satisfy the materiel need. Market surveillance should be a continuous activity of the Coast Guard Research and Development Center. It is the activity by which the Coast Guard can maintain an awareness of the technologies and products being developed in the private sector (including foreign products) that may be adaptable for Coast Guard use.

NDI feasibility is assessed based on the initial operational requirements developed by the Program Sponsor and the available market surveillance information. Since no formal method exists to ensure that human performance issues are identified during the NDI feasibility determination, the HSI constraints and goals included in the HSISMP and early requirements documents must be communicated to those responsible for conducting the market surveillance.

If an NDI acquisition strategy is determined feasible, a market investigation is conducted. The market investigation involves a detailed search for information tailored to the specific materiel need. The HSISMP serves as the basis for developing the operational issues and evaluation criteria to be addressed.

As a result of the market investigation, an assessment is made of the availability of hardware and software that meets the operational and performance requirements. Additionally, performance limitations and possible requirements trade-offs are identified. As the user requirements become more defined, the ORD is developed, which serves as the basis for the solicitation.

3.4 Tailoring and Streamlining the Acquisition Process. While the traditional full development program considers the full range of complexity and risk factors for a wide spectrum of programs, the need to reduce costs and effect early fielding encourages tailoring and streamlining of all acquisition alternatives. The ultimate goal of acquisition streamlining is to reduce the cost and time it takes to field operationally suitable materiel systems and their supporting services.

Streamlining is a combination of common sense measures to achieve the "surest and shortest" path of low-risk development programs. It is a tailored development approach that emphasizes

performance-oriented requirements and the pursuit of materiel solutions using mature components or subsystems.

3.4.1 HSI in Acquisition Streamlining. The application of HSI in streamlining an acquisition is essentially the same as for a traditional development program. Streamlining can reduce the full development time from 2 to 8 years. The decision matrix/criteria shown in Exhibit E-2 should be followed in making the initial assessment as to the level of HSI effort required for the system under consideration and to determine whether or not an abbreviated HSI System Management Plan or a full management plan is appropriate.

The following paragraphs describe streamlining and tailoring considerations throughout the acquisition process.

a. Requirements Determination. The HSISMP is the key human performance document for the streamlined approach. An early understanding of the HSI issues associated with the application of new technology is necessary so that an acquisition strategy that addresses the full range of NDI, materiel change, and full development solutions can be developed. Front-End Analyses specified in the HSISMP will assist in defining the extent of HSI issues and their impact on expected system performance. HSI analyses and technical base activities will assist in the development of system requirements that are stated in operational terms with allowable bands of performance.

b. Proof-of-Principle Activities. The proof-of-principle phase provides about a 2-year period to prove out the technologies selected for inclusion in the new system and to formalize the concept formulation process. It allows for an early "pulse check" with senior leadership on the system requirements and basic program acquisition strategy approach. The phase is concluded with a combined KDP-2 and-3 "go/no go" decision that can permit a program to proceed directly to Full Scale Development and then to Production.

   Since much of the information available early in the acquisition process will come from the market investigation, HSI issues identified in the HSISMP must be addressed. The results of the market investigation will form the basis for an acquisition strategy decision and will finalize the ORD. Marketplace features (equipment characteristics) that enhance human performance must be identified and included as system requirements in the ORD. Unrealistic requirements, those which add little value, and those that detract from human performance, must be eliminated.

   The selection of the acquisition strategy (incorporation of NDI, materiel change, or full development) is closely linked with the requirements process. It is often necessary for the user to identify performance requirements that can be traded off to make an acquisition alternative viable. The results of HSI analyses will

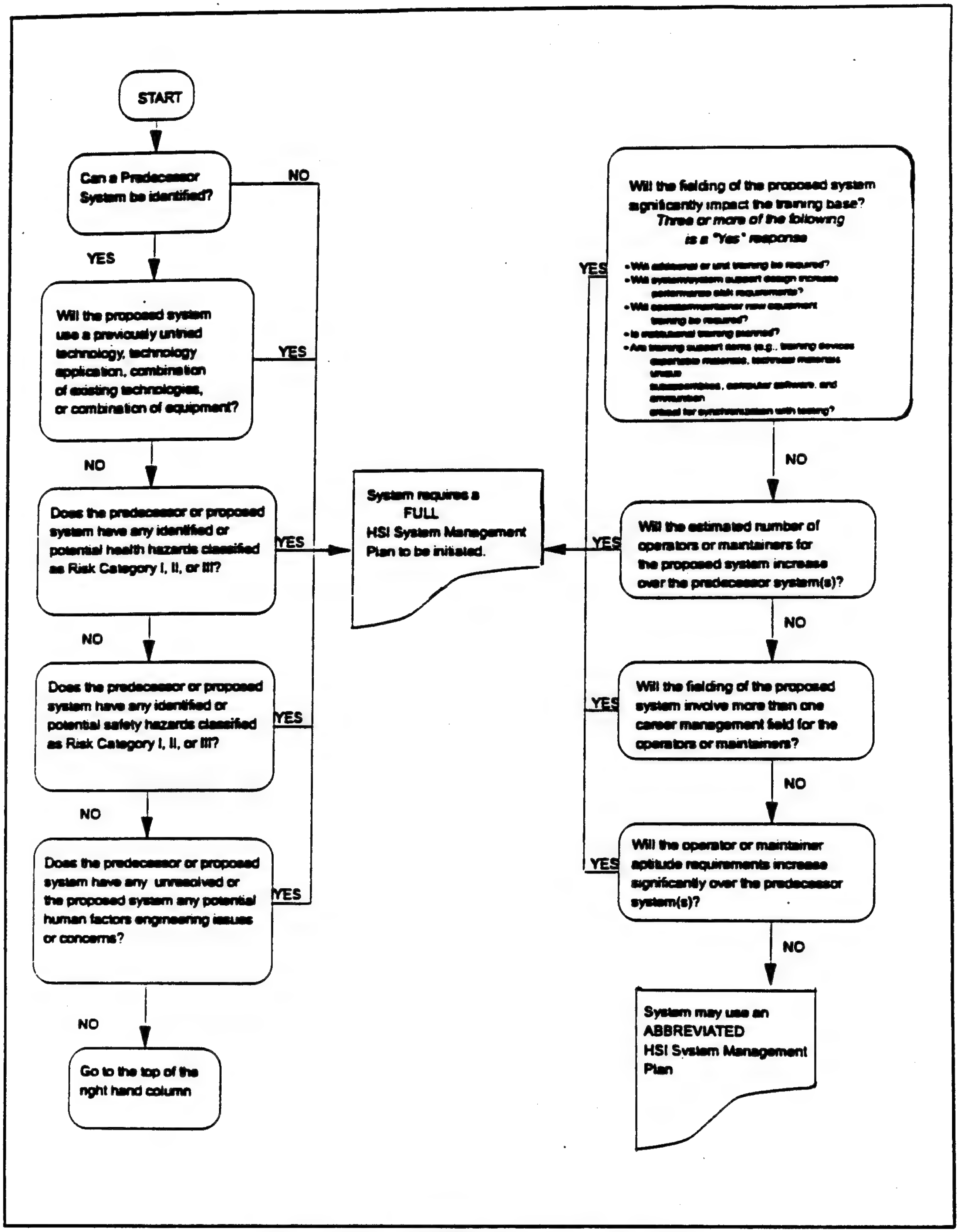


**Exhibit E-2. HSISMP Decision Graphic**

provide the decision makers with information that will make this process easier. Care must be taken to ensure that undesirable features are not added for the sake of "making the system work."

Proof-of-principle activities stress user experimentation and personnel demonstrations with "brassboard" systems, components, and surrogates or models to prove out the operational concept before proceeding to Full Scale Development. Inclusion of HSI issues and criteria in the Test and Evaluation Master Plan ensures that human performance information will be collected and addressed during the test program.

c. Development Proveout Activities. Development proveout activities focus on the integration of the mature technologies and systems demonstrated during proof-of-principle. This phase includes the Full Scale Development of hard-tooled prototypes and low rate production items prior to actual entry into full rate production.

Residual HSI issues documented in the HSISMP are addressed through operational/pre-production testing prior to a KDP-4 decision. Integrated technical/user testing is used to the maximum extent possible to reduce test costs and time requirements. Early testing and continuous evaluation reduce the risk that the hard-tooled prototypes will have human performance problems that may require significant engineering changes. The results of testing should allow type classification, thereby permitting a production decision.

Solicitation and contractual documents are streamlined by including a minimum of "how to" guidance and eliminating non-productive or non-cost effective data requirements. Tailoring of data items to the information absolutely necessary to satisfy specific HSI and other requirements can result in substantial savings. Human performance information can be obtained by using safety, health hazards, ILS, and HFE Data Item Descriptions (DIDs) and data requests.

d. Full Rate Production and Initial Deployment. The transition from hard-tooled prototypes to production items provides minimal opportunity for major design changes. Therefore, the HSI efforts during this phase center on source selection and supportability. HSI should be accorded equal priority with other system characteristics to ensure effective human-equipment interface. HSI criteria must be an integral part of all selection criteria in each area of proposal evaluation.

During initial deployment, the system's supportability must be thoroughly reviewed to assess its HSI impact and provide a baseline for evaluating proposed engineering change proposals. HSI data collected will provide the foundation for the development of next generation and notional systems.

e. Other Streamlining Considerations. The following are four practical considerations in streamlining acquisitions.

(1) Don't let "better" be the enemy of "good enough." Success in streamlining rests in large part on willingness to limit objectives -- to stick to mature technology when the temptation is to go for a high technology breakthrough.

(2) Maximize coordination and cooperation. Streamlining will not make the job easier; rather, it requires additional effort to ensure that all bases are covered and everyone is in agreement with the program.

(3) Minimize verbiage. Rigorous writing is concise. Don't waste words.

(4) If it doesn't make sense, don't do it. In streamlining, nothing is sacred. Too many requirements exist only because they were in a previous solicitation or program. Challenge them. If they provide little or no benefit to a program, they should be eliminated.

These rules, coupled with common sense and trust, form the basis of effective streamlining. They apply equally to government and industry because both have the same fundamental goal -- to get quality equipment into the hands of the Coast Guardsman more quickly and at a reduced cost. Streamlining can make it happen.

## SECTION F
## IMPLEMENTING HSI IN COAST GUARD ACQUISITION PROCESS

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# SECTION F
# IMPLEMENTING HSI IN COAST GUARD ACQUISITION PROCESS

In Section A, paragraph 5 of the Coast Guard HSI Program Requirements Document (the first deliverable in this Project), we described several potential staff organization options in assigning management responsibility for implementing the HSI Program in Coast Guard acquisitions. No final organizational recommendation was made at that time, pending completion of the Coast Guard HSI Process Model. The HSI Process Model, as described in this document, has further defined the various activities that must be completed, the coordination required, and the recommended management structure necessary to properly manage HSI through the Coast Guard procurement process. Accordingly, based on our understanding of the Coast Guard acquisition system and the HSI Process Model as described herein, we now have enough information to recommend staff organizational assignments to efficiently integrate HSI into the process. The following paragraphs describe the recommended staff organizational responsibility for managing the HSI Program.

1. <u>OFFICE RESPONSIBLE FOR THE HSI PROGRAM</u>. The early involvement of OHSIP in each acquisition well in advance of the PMs assignment; the coordination required between the HFE and the Design Engineers to work design changes from all five domains and the wide array of organizations the OHSIP must successfully interface with in performing their HSI duties — all three factors support and reenforce our earlier findings that the strongest, most workable organizational option for managing HSI is a separate HSI Program Office established in the Office of Acquisition.

If the HSI Program is to succeed, it must impact system design. To influence system design, the OHSIP must start the Front-End Analysis and MAPTIDES Methodology early in the Project Initiation Phase. OHSIP must also establish effective interface relationships with other staff organizations as described in Section C. To accomplish these critical tasks, OHSIP needs the strategic positioning offered by assignment to the Office of Acquisition. Assignment to the organization responsible for the proper functioning of the Coast Guard acquisition process will provide OHSIP the most effective positioning to mold and fit the HSI Program into the existing acquisition process. This organizational positioning will also allow OHSIP to smoothly and successfully establish the various working relationships required and to be involved with the Program Sponsor in the early stages of each new acquisition.

For HSI to successfully impact system design, the Human Factors Engineer (HFE) must coordinate domain problems impacting design with the domain expert to find an acceptable solution. The HFE must then coordinate the solution with Design Engineers to alter the design and resolve the domain issue. To effect this coordination, the HFE must be involved on a regular basis with both systems and design engineering (including hardware/software contractors) to understand enough about the current design to develop credible alternatives in solving domain issues. This process will work better and the HFE will be more credible with the engineering

organizations if the OHSIP is assigned to the Office of Acquistion, which is dedicated to making the whole acquisition process work.

To properly implement HSI, the OHSIP must interface at some time with almost every organization in the Coast Guard (although perhaps not on every acquisition). These interfaces and the relationships established will be more credible and more amicable if OHSIP is from an organization that does not represent a particular interest or function. Here again, the Office of Acquisition is the best choice.

In addition, solely dedicating the HSI Team to managing HSI in all system acquisitions builds expertise and promotes continuity in HSI requirements development, domain procedures, and documentation from one acquisition to the next. This arrangement also promotes building extensive lessons-learned data bases in each domain over time.

For all of these reasons, we recommend the HSI Program Office be established as a separate Branch and be located in the Office of Acquisition.

2.1 HSI PROGRAM OFFICE STAFFING. All HSI domains can be covered by specialists assigned to the following five positions. Specialists in these positions will coordinate their domain requirements and products with the office indicated. This coordination is a way of focusing and utilizing Coast Guard institutional HSI domain expertise to ensure the best possible inputs for each system acquisition; additionally, this is a way to keep the coordinating offices advised of new HSI requirements in their areas of responsibility.

| Position | Coordinating Office |
|---|---|
| Human Factors Engineer | Coast Guard R&D Center |
| Safety Engineer | G-K |
| Manpower Specialist | G-CPA |
| Personnel Specialist | G-PWP |
| Training Specialist | G-PRF |

The HSI Program Office should be headed by a Human Factors Engineer because the HFE is specifically trained in all HSI domains. In addition, the HFE brings to the HSI team an engineering perspective to resolve design issues in all domains and to coordinate those resolutions with Design Engineers. The HFE understands systems engineering and design and will be a credible member of the acquisition team in resolving HSI domain problems and reflecting those corrections in the system design.

Since there are no Human Factors Engineers or Safety Engineers on the staff, this option will require the Coast Guard to invest in the HSI Program by creating two positions and hiring a Human Factors Engineer and Safety Engineer. This organization option ensures by far the most

effective HSI Program over the other options. For a relatively small investment in manpower, the Coast Guard will gain an HSI capability that is not present today. In addition to greatly improved system performance, this program will result in cost avoidance that is much greater than the manpower costs required to implement HSI.

# APPENDIX A

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| 4105.2 | (Draft) Acquisition and management of Integrated Logistics Support (ILS) for Coast Guard Systems and Equipment |
| M4105.2 | Acquisition Review council, Coast Guard (CGARC) |
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| M5400.7C | Organization Manual |
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**Headquartes Instructions**

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| 4200.10 | Acquisition Review Council, Coast Guard (CGARC) |

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| MIL-STD-280 | Definition of Item Levels, Item Interchangeability, Models and Related Terms |
| DoD-HDBK-292 (Navy) | Training Materials Development |
| MIL-STD-480B | Configuration Control—Engineering Changes, Deviations, and Waivers |
| MIL-STD-483A (USAF) | Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs |
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| MIL-STD-1294 | Acoustical Noise Limits in Helicopters |
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| MIL-STD-1388-1A | Logistic Support Analysis |
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| DoDD 4210.15 | Hazardous Material Pollution |
| DoDD 5000.1 | Major System Acquisition |
| DoDD 5000.4 | OSD Cost Analysis Improvement Group |
| DoDD 5000.49 | Defense Acquisition Board |

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| DoDI 5000.2 | Major System Acquisition Procedures |
| DoDI 6050.5 | Hazard Communication Program |
| DoDI 7041.3 | Economic Analysis and Program Evaluation for Resource Management |
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| AR 40-5 | Health and Environment |
| AR 40-10 | Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process |
| AR 40-14 | Control and Recording Procedures for Exposure to Ionizing Radiation and Radioactive Materials |
| AR 40-46 | Control of Health Hazards from Lasers and Other High Intensity Optical Sources |
| AR 40-501 | Standards of Medical Fitness |
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| AR 385-30 | Safety Color Code Marking and Equipment |
| AR 385-32 | Protective Clothing and Equipment |
| AR 385-61 | Safety Studies and Reviews of Chemical Agents and Associated Weapon Systems |
| AR 385-64 | Ammunition and Explosive Safety Standards |
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| AMC PAM 700-21 | Integrated Logistic System Contracting Guide |
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| NAVFAC P-80 | Facilities Planning Factor Criteria for Navy and Marine Corps Shore Installations |
| NAVPERS 18068 (series) | Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards |
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| P-111-10-85 | HARDMAN Aviation MPT Concept Review Guide |

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| P-111-8-85 | HARDMAN E/S/S MPT Concept Document Review Guide |
| P-111-4-85 | MPT Data Sources Directory: Analyst's Guide |
| P-111-3-85 | HARDMAN Methodology: Total Ship |
| P-111-2-85 | HARDMAN Methodology: Aviation |
| P-111-1-85 | HARDMAN Methodology: Equipment/System/Subsystem |
| ----- | Total Ship Preliminary Manpower Report Review Guide |
| ----- | HARDMAN Training Workshop Instructor's and Participant's Manual (available for E/S/S and Aviation versions) |

# APPENDIX B

## LIST OF ACRONYMS

| | |
|---|---|
| ADM | Advanced Development Model |
| AFQT | Armed Forces Qualification Test |
| AP | Acquisition Plan |
| ASVAB | Armed Forces Vocational Aptitude Battery |
| | |
| BCM | Baseline Comparison Model |
| BCS | Baseline Comparison System |
| | |
| CBA | Cost Benefit Analysis |
| CCB | Configuration Control Board |
| CDRL | Contract Data Requirements List |
| CGTP | Coast Guard Training Plan |
| CM | Corrective Maintenance |
| CO | Chief of Naval Operations |
| CPS | Contractor Plan Services |
| | |
| DCNO | Deputy Chief of Naval Operations |
| DCNO(MPT) | Deputy Chief of Naval Operations for Manpower, Personnel and Training |
| DCSPR | Deputy Chief of Staff for Personnel (Army) |
| DID | Data Item Description |
| DISC | Command, Control, Communications, Computers (Army) |
| DMSO | Director, Major Staff Office (Navy) |
| DoD | Department of Defense |
| DoT | Department of Transportation |
| | |
| EA | Evolutionary Acquisition |
| ECP | Engineering Change Proposal |
| EMDM | Enhanced Manpower Determination Model |
| EMR | Enlisted Master Record |
| EPA | Environment Protection Agency |
| EPR | Equipment Facility Report |
| E/S/S | Equipment/Systems/Subsystem |
| | |
| FEA | Front-End Analysis |
| FM | Facility Maintenance |
| FRS | Fleet Replacement Squadron (Navy) |

| | |
|---|---|
| G-CPA | Programs Division, Chief of Staff Office |
| GFE | Government Furnished Equipment |
| G-P | Office of Personnel and Training |
| HARDMAN | Military Hardware/Manpower Integration (Navy) |
| HEPP | Human Engineering Program Plan |
| HFE | Human Factors Engineering |
| HHPP | Health Hazard Program Plan |
| HIS | HARDMAN Information System |
| HSI | Human Systems Integration |
| HSIJWG | HSI Joint Working Group |
| HSISMP | Human Systems Integration System Management Plan |
| IEM | Initial Estimate of Manpower |
| ILS | Integrated Logistics Support |
| ILSP | Integrated Logistics Support Plan |
| IMPACTS | Integrated Manpower, Personnel, and Comprehensive Training and Safety (Air Force) |
| ISD | Instructional System Development |
| JMSNS | Justification for Major System New Start |
| KDP | Key Decision Point |
| KSA | Knowledge, Skills, and Abilities |
| LCC | Life-Cycle Cost |
| LCCE | Life-Cycle Cost Estimate |
| LSA | Logistics Support Analysis |
| MANPRINT | Manpower and Personnel Integration (Army) |
| MAPTIDES | Manpower, Personnel and Training Integration in the Design of Systems |
| MCP | Materiel Change Packages |
| MIL-STD | Military Standard |
| MJWG | MANPRINT Joint Working Group |
| MNS | Mission Need Statement |
| MPT | Manpower, Personnel, and Training |
| MPTCD | Manpower, Personnel, and Training Concept Document |
| MPTRRD | Manpower, Personnel, and Training Resource Requirement Document |

| | |
|---|---|
| NATO | North Atlantic Treaty Organization |
| NAVAIR | Naval Air Systems Command |
| NAVMAC | Navy Manpower Analysis Center |
| NAVSEA | Naval Sea Systems Command |
| NDI | Non-Developmental Item |
| NMRS | Navy Manpower Requirements System |
| NTP | Navy Training Plan |
| NTPC | Navy Training Plan Conference |
| | |
| OBT | Onboard Training |
| OHSIP | Office Responsible for the Human Systems Integration Program |
| OJT | On-the-Job Training |
| OLSP | Operational Logistics Support Plan |
| OM | Operational Manning |
| OPNAV | Office of the Chief of Naval Operations |
| ORD | Operational Requirements Document |
| OSHA | Occupational Safety and Health Administration |
| OUS | Own Unit Support |
| | |
| PAL | Personnel Allowance List |
| PHA | Preliminary Hazard Analysis |
| PLM | Planned Maintenance |
| PM | Program/Project Manager |
| PMP | Project Management Plan |
| PMR | Preliminary Manpower Report |
| POE | Projected Operating Environment |
| POM | Program Objective Memorandum |
| PORD | Preliminary Operational Requirements Document |
| PS | Program Sponsor |
| PSQMD | Preliminary Squadron Manpower Document |
| PVMD | Preliminary Vessel Manpower Document |
| | |
| RAMPARTS | Manpower, Personnel, and Requisite Training and Safety (Air Force) |
| RFP | Request for Proposals |
| ROC | Required Operational Capability |
| RS | Resource Sponsor |

| | |
|---|---|
| SECNAV | Secretary of the Navy |
| SHA | System Hazard Analysis |
| SMD | Ship Manpower Document |
| SMMP | System MANPRINT Management Plan |
| SQMD | Squadron Manpower Document |
| SSE | System Safety Engineering Office |
| SSEB | Source Selection Evaluation Board |
| SSHA | Subsystem Hazard Analysis |
| SS/HH | System Safety/Health Hazards |
| SSPP | System Safety Program Plan |
| SYSCOM | Systems Command (Navy) |
| | |
| TAD | Target Audience Description |
| T&E | Test and Evaluation |
| TEMP | Test and Evaluation Master Plan |
| TIWG | Test Integration Working Group |
| TOA | Trade-off Analysis |
| | |
| WSR | Work Station Requirement |

## APPENDIX C

## DESCRIPTION OF ARMY MANPRINT PROGRAM

1. Governed by Army Regulation 602-2 titled Manpower and Personnel Integration (MANPRINT) in Material Acquisition Process

2. MANPRINT includes six domains

   a. Human Factors Engineering
   b. System Safety
   c. Health Hazards
   d. Manpower
   e. Personnel
   f. Training

3. Deputy Chief of Staff for Personnel (DCSPER) has policy responsibility for the program

4. Two subordinate Major Army Commands have primary responsibility for implementing the MANPRINT Program

   a. Training and Doctrine Command (TRADOC)

      (1) Responsible for MANPRINT requirements
      (2) Has published numerous procedural guides

   b. Army Material Command (AMC)—Responsible for system design and development

      (1) Translates Combat Developers MANPRINT goals and constraints into system specifications and solicitation documents

      (2) Has published a number of handbooks on how to include MANPRINT in system design and development

5. MANPRINT goals

   a. Improve system performance
   b. Improve manpower and personnel utilization
   c. Improve unit effectiveness

6. Scope of MANPRINT Program

   a. Developmental

b. Non-developmental
c. Material change programs
d. Nonstandard commercial equipment items

7. Designed primarily as a bottoms-up approach to answer the question "Can this soldier, with this training and equipment, perform these tasks to these standards under these conditions"

8. MANPRINT seeks to optimize total system performance by considering the soldier as an integral part of the material system—This total system includes three components: equipment, environment, and soldier

   a. Equipment—Hardware and software— Including factors that affect equipment variability (e.g., reliability, redundancy, accuracy, and safety) that impact soldier performance and can be designed to complement the soldier

   b. Environment—Including variables such as isolation, heat, noise, weather, continuous operations, battlefield environment including nuclear, biological, and chemical (NBC) warfare and fear, and organizational structure in which the system must operate—Environment is a consideration when assessing the ability of the soldier to perform as part of the total system

   c. Soldier—Trained operators, maintainers, and support personnel—Soldier performance variables parallel the domains of MANPRINT, including numbers (manpower), quality (personnel), skills (a combination of aptitude and training), soldier-machine interface (human factors), and risks (safety and health hazards)—These variables must be consistent with those in equipment and environment in choosing among design alternatives.

9. MANPRINT Process—Specific actions that must be accomplished to ensure that soldier performance issues are identified, addressed, and managed throughout the design, development, and acquisition of a new material system

   a. Identification of a materiel need

   b. Front-End Analysis to provide information needed to resolve MANPRINT issues and include MANPRINT criteria in program documentation

   c. Formation of a MANPRINT Joint Working Group

   d. Development of a System MANPRINT Management Plan (SMMP) to manage these issues—Including identification of the Target Audience Description (TAD)

   e. Documentation of total system performance requirements and specifications, including:

(1) MANPRINT constraints
(2) MANPRINT assessment
(3) Test and Evaluation Master Plan (TEMP)

10. MANPRINT Responsibilities in individual acquisitions

a. Combat Developer—Identifies a battlefield deficiency that cannot be resolved with a change in doctrine, training, or organization

(1) Performs early studies and analysis to determine initial MANPRINT requirements

(2) Represents user member and co-chair of MJWG

(3) Performs MANPRINT assessments in conjunction with Material Developer for smaller acquisitions

b. Material Developer—Translates Combat Developer's MANPRINT goals and constraints into system specifications and solicitation documents

(1) Member and co-chair of MJWG

(2) Conducts analysis and produces reports and plans in support of SMMP soldier performance information requirements, including the following:

(a) Human Factors Engineering Assessment (HFEA)
(b) Safety Assessment Report (SAR)
(c) Test and Evaluation Master Plan (TEMP)
(d) Integrated Logistic Support Plan (ILSP)

c. Program Executive Officer/Program Manager (PEO/PM)

(1) Has overall management and decision authority for a program

(2) Considered MANPRINT requirements when establishing cost, scheduling, and performance baselines

(3) Industries responsiveness to MANPRINT issues is based largely on perception of MANPRINT's importance to PEO/PM

11. Membership of MJWG—Membership is tailored based on soldier performance issues of the system—Can be altered as new issues are identified

a. Combat Developer—Convenes and chairs MJWG prior to Milestone 1—AT Milestone 1 and beyond the Combat Developer and Material Developer co-chair the MJWG

b. Material Developer—Transitions program management responsibilities to PEO/PM at Milestone 1

c. Trainer Developer

d. Manpower/Personnel Proponent

e. Director of Standardization and Evaluation

f. Safety Office

g. PM

h. May also have following members

   (1) Army Research Institute
   (2) Human Engineering Laboratory
   (3) Test and Evaluation Community
   (4) Other supporting TRADOC schools

12. Development of System MANPRINT Management Plan

   a. Army developed SMMP to resolve two critical weaknesses in the acquisition management process:

      (1) Neither program nor requirements documents provided insight to what soldier can and cannot do

      (2) The impact of fielding a new system on the soldier was not controlled because of insufficient management visibility

   b. SMMP is the sole-source MANPRINT document

      (1) Serves as a planning and management guide

      (2) Provides an audit trail to track MANPRINT issues and concerns prior to and throughout development and fielding of a new system

      (3) Identifies the MANPRINT—related tasks, analysis, trade-offs, and decisions that are affected during the material acquisition process

   c. SMMP is structured in five sections

      (1) Section 1 — Executive Summary

      (2) Section 2 — System Description

(3) Section 3 — MANPRINT Strategy — Objectives and strategy to achieve objectives

(4) Section 4 — Critical Issues — Defines major risk areas

(5) Section 5 — Tabs

Tab A - Data Sources
Tab B - System and MANPRINT Milestone Schedule
Tab C - Task Description
Tab D - MANPRINT Major Issues/Concerns
Tab E - Coordination
Tab F - Audit Trail
Tab G - Target Audience Description
Tab H - Lessons Learned and Deficiencies of Predecessor System

d. SMMP Initiation and Approval

(1) The Combat Developer of the Training Developer will initiate the SMMP after a battlefield deficiency has been identified that requires a new or improved material system

(2) The Combat or Training Developer remains the lead for SMMP but the MJWG provides assistance in addressing domain specific issues

(3) The SMMP is jointly approved by the Combat Developer (the initiating agency and user representative) and the Army Material Command (the implementing agency and material developer) 30 days prior to each milestone decision review

e. SMMP Emphasis

(1) Pre Milestone 1: Focuses on influencing design — Emphasis is on identifying existing guidance, predecessor and comparable systems, data sources, areas of concern, and analysis that will be required

(2) Post Milestone 1: Focuses on system's operational supportability from a manpower, personnel and training perspective; resolution of issues; and integration of soldier performance issues in other program documents to achieve system MANPRINT objectives

f. MANPRINT Information Categories — SMMP manages the overall MANPRINT effort, which includes plans for identifying, collecting, evaluating, and applying information to influence design and system selection

(1) MANPRINT Information is included in five main categories

(a) Deficiency Information/Performance Requirements — What aspects of the predecessor system need to be improved?

(b) Program Guidance — What decisions have been made that impact resources (e.g., manpower, personnel, or training base resources)?

(c) Lessons Learned — What have we learned in designing and operating previous systems that we want to improve in a new system?

(d) Prediction — Have the abilities and limitations of the future soldier been considered when determining the total system performance requirements of the new system?

(e) Assessment — Have key information source documents and analysis been completed adequately? Are there unresolved MANPRINT issues that need to be addressed?

13. Front-End Analyses (FEA) — Influences design or system requirements and may impact alternative concept selections by identifying MANPRINT constraints, Limitations, and objectives

a. Includes analyses of the following Mission and Support System Definition tasks:

(1) Task 1 Use study — Identifies and documents pertinent supportability factors of the proposed system

(2) Task 2 Mission Hardware, Software, and Support System Standardization — Defines design constraints of proposed system based on existing and planned logistic support resoruces — Also provides supportability input to mission hardware and software standardization efforts

(3) Task 3 Comparative Analysis — Develops a baseline comparison system representing the characteristics of the proposed equipment

(4) Task 4 Technological Opportunities — Identifies technological advancements and state-of-the-art design approaches which offer opportunities for achieving improvements in the new system

(5) Task 5 Supportability and Supportability-Related Design Factors

14. MANPRINT Reviews and Assessments

a. Reviews — Conducted to determine status and adequacy of MANPRINT efforts

(1) Normally held in conjunction with ILS Management Team reviews

(2) Program Sponsor/PM responsible for reviews

(3) Results are documented in appropriate program decision documents

b. Assessments — Conducted prior to each milestone decision review

(1) Determine status and adequacy of MANPRINT efforts and presents any unresolved MANPRINT issues or concerns to decision makers

(2) For major programs, DCSPER conducts assessment — AMC, TRADOC or other designated MACOM conducts assessment for non-major programs

15. Test and Evaluation — Observes system performance during acquisition process

a. MANPRINT looks beyond individual domain issues to test and evaluate system's total operational capability

b. Testing is tailored by Test Integration Working Group

c. MANPRINT T&E includes following types of testing (tailored by TIWG to fit requirements of each acquisition)

(1) Prototype and Surrogate Testing

(a) Force Development T&E
(b) Concept Evaluation
(c) Technical Feasibility Testing
(d) Operational Feasibility Testing

(2) Component Level Testing

(a) Developmental Testing
(b) Early User Test and Evaluation

(3) Full Scale Testing

(a) Preproduction Testing
(b) Initial Operational T&E (IOT&E)
(c) Preproduction Qualification Testing
(d) Live Fire T&E (Combat Systems)

(4) Production & Deployment/Operational Testing

(a) Production Qualification Testing
(b) Follow-on T&E

d. Test and Evaluation Master Plan (TEMP) — Planning document that identifies critical technical and operational issues as well as all planned test activities

(1) TEMP is prepared by TIWG and provides interface between TIWG and other Army activities conducting testing

(2) Test issues and criteria are jointly developed by the TIWG and MJWG

(3) If an issue is not planned for testing in TEMP it probably will not be tested

e. MANPRINT includes three other test-related documents

(1) Technical Independent Evaluation Plan — Addresses safety, health, and Human Factors Engineering issues

(2) Operational Independent Evaluation Plan — Focuses on soldier performance issues

(3) Test Design Plan — Describes conditions and standards for required testing

(a) How and when will test be conducted — Operational environment

(b) Number and quality of soldiers to be used — Manpower and personnel

(c) Test player preparation program — Training

f. MANPRINT in Life Cycle System Management Model (LCSMM)

(1) Primary objective of MANPRINT is to influence system design by considering soldier performance as an integral part of total system operation

(2) This MANPRINT objective is achieved by integrating MANPRINT considerations and constraints into the program management documents that drive design and supportability aspects of the developing system in each phase of LCSMM

(3) Standards are used in an interactive process of definition, synthesis, trade-off, test, and evaluation — The aim is to achieve the best balance between cost, schedule, performance, and supportability

## APPENDIX D

## DESCRIPTION OF NAVY HARDMAN, PLUS REMAINING NAVY HSI PROGRAM

1. The Navy Hardware/Manpower Integration (HARDMAN) Program is governed by OPNAVINST 5311.7 titled "Determining MPT Requirements for Navy Acquisitions". The HARDMAN Program includes only the Manpower, Personnel, and Training Domains.

2. SECNAVINST 5000.2A titled "Defense Acquisition Management Policies and Procedures, Implementation of" is a new instruction (December 1992) aimed at implementing the DoD HSI Program in Navy acquisition. This instruction reaffirms use of the HARDMAN Program to determine MPT requirements and also specifies that Human Factors Engineering and System Safety/Health Hazard Domains will be included in system design for new Navy acquisitions.

3. The Navy realized the need for HFE and SS/HH as early as 1983 when the Naval Materiel Command issued NAVMATINST 3900.9A titled "Human Factors in the Naval Materiel Command." This instruction required Navy Systems Commands to use all the elements of the current DoD HSI Program in the design and development of system acquisitions (although without the emphasis on integration of the elements). This prompted each Systems Command to publish their own instructions, with NAVSEA publishing NAVSEAINST 3900.8 titled "Human Factors in the Naval Sea Systems Command" in 1984, followed in 1986 by the Naval Air Systems Command publishing NAVAIRINST 3900.10 titled "Lead System Command Policy for Human Factors."

4. The HARDMAN Program is well documented down to the analyst level of detail. Appendix A includes publications supporting the HARDMAN Program and other Navy HSI requirements.

5. Since early 1992, the Navy has had a contractor updating most of the HARDMAN publications. In discussions with the contractor, he indicates that the basic steps in each methodology has not changed, but the data collection and final reports are being automated. Some procedural changes are also being included.

6. Deputy Chief of Naval Operations for Manpower, Personnel, and Training (OP-01) has policy responsibility for the HARDMAN Program. Navy System Commands (through Program Managers) are responsible for system design, development, and implementation of HSI, while OP-01 reviews and approves the completed draft MPT plans for Navy acquisitions. No single organization has overall responsibility for HSI in the Navy. This is a significant weakness compared to the Army MANPRINT Program.

7. The HARDMAN Methodology is an iterative process designed to meet the following objectives:

   a. Satisfy MPT planning and reporting requirements in the system acquisition process, particularly during the pre-Milestone I period

   b. Identify critical MPT issues

   c. Provide early estimates of MPT requirements

   d. Identify high MPT drivers

   e. Provide manpower/hardware trade-off analysis data

   f. Integrate MPT requirements into the system design and decision-making process

   g. Develop and maintain an audit trail to support MPT decisions during the acquisition process

   h. Establish an MPT data base for subsequent development of system acquisition documentation, including Navy Training Plans, Integrated Logistic Support Plans, and other manpower-related documents and requirements

8. The Navy program calls for the following manpower planning as part of Integrated Logistic Support:

   a. <u>Prior to Program Initiation (Milestone 0)</u>

      Manpower resource constraints must be identified in the Justification for Major System New Start. If appropriate, these constraints should be based on an analysis of systems currently in the mission area.

   b. <u>Prior to Milestone I</u>

      Manpower implications of alternative operational and support concepts must be evaluated; the requirements must be identified and determined to be consistent with updated program constraints. Manpower cost drivers of current systems must be identified and potential for improvement established. Manpower parameters critical to system readiness must also be identified.

   c. <u>Prior to Milestone II</u>

      A consistent set of manpower goals and thresholds must be established and compared to a baseline system. The sensitivity of manpower resource requirements to changes in key parameters and the associated impacts on readiness must be analyzed. Manpower requirements by work center must be identified based on design, support, and readiness trade-off analyses.

Requirements for unique skills or specialties which are in short supply must be identified.

d. Prior to Milestone III

Manpower requirements must be validated to assure goals for peacetime readiness and wartime employment are met. A preliminary manpower document and support analysis (including comparison by work center to a baseline system) must be available and manpower requirements must be satisfied by projected assets.

9. The following are principal requirements contained in the HARDMAN instruction (OPNAVINST 5311.7). See Exhibit App D-1 for MPT considerations by acquisition phase.

a. Establishment of an MPT Advisory Board

Early in program development an informal MPT Advisory Board will be created and established formally in writing. The advisory board shall provide the PM with subject matter expert (SME) support, review and evaluation, and assist the PM to identify and address MPT issues.

b. Development of an MPT Concept Document (MPTCD) prior to Milestone I

The MPTCD shall identify the projected use of manpower to satisfy operator and maintainer requirements and training requirements for the new system. This document will be prepared by the Project Management Office (PMO) and forwarded to the MPT Advisory Board for review and comment prior to Milestone I.

c. Development of an MPT Resource Requirements Document (MPTRRD) prior to Milestone I

The MPTRRD shall identify the MPT resources necessary to support the operation, maintenance, and training concepts developed in the MPTCD. The first iteration of the MPTRRD will be forwarded to the MPT Advisory Board in time for review and comment prior to the scheduled Milestone I program review. Following this review, the MPTRRD will be updated to reflect acquisition concept changes and will be the PM's statement of MPT requirements until the draft Navy Training Plan (NTP) is approved.

10. The Navy Training Plan instruction, OPNAVINST 1500.8 series titled "Navy Training Planning Process", is the keystone for the planning of Navy training. It establishes policies, procedures, and assigned responsibilities for the planning, programming, and implementing actions necessary to provide manpower, personnel, and training support for ships, aircraft, equipment, systems, subsystems, and non-hardware oriented

PROGRAM INITIATION — (POM) — CONCEPT EXPLORATION — (I) — DEMONSTRATION AND VALIDATION — (II) — FULL SCALE DEVELOPMENT — (III) — PRODUCTION AND DEPLOYMENT

- IDENTIFICATION OF MANPOWER CONSTRAINTS FOR INCLUSION IN THE JMSNS

- ANALYSIS OF MANPOWER DRIVERS IN CURRENT SYSTEMS
- EVALUATION OF MANPOWER IMPLICATIONS OF ALTERNATIVE OPERATIONAL AND SUPPORT CONCEPTS
- IDENTIFICATION OF MANPOWER REQUIREMENTS CONSISTENT WITH PROGRAM CONSTRAINTS
- IDENTIFICATION OF MANPOWER DRIVERS OF CURRENT SYSTEMS AND TARGETS FOR IMPROVEMENT IN THE NEW SYSTEM
- IDENTIFICATION OF CRITICAL MANPOWER PARAMETERS TO SYSTEM READINESS AND SUPPORT; ESTIMATION OF ACHIEVABLE VALUES COMPARED TO CURRENT SYSTEMS
- MPT CONCEPT (MPTC) DEVELOPMENT
- MPT RESOURCE REQUIREMENTS (MPTRR)
- PROJECT ACQUISITION STRATEGY DEVELOPMENT
- INCLUSION OF MANPOWER CONSIDERATIONS IN RFP, SOURCE SELECTION AND CONTRACTS

- CONDUCT OF TRADEOFFS AMONG SYSTEM CHARACTERISTICS, MANPOWER, AND SUPPORT CONCEPTS TO MEET PEACETIME READINESS AND WARTIME EMPLOYMENT OBJECTIVES
- ESTABLISHMENT OF A SET OF MANPOWER GOALS AND THRESHOLDS CONSISTENT WITH CONTEMPORARY BASELINE SYSTEM
- EVALUATION OF MANPOWER REQUIREMENTS FOR CHANGES IN KEY PARAMETERS AND EVALUATION OF ASSOCIATED IMPACTS ON SYSTEM READINESS

ESTIMATION OF MANPOWER REQUIREMENTS BY WORK CENTER CONSISTENT WITH ESTABLISHED GOALS AND THRESHOLDS (PSMD/PSOMD)

- IDENTIFICATION OF UNIQUE SKILLS OR SPECIALTIES WHICH ARE IN SHORT SUPPLY
- NAVY TRAINING PLAN (NTP) DRAFT

- ANALYSIS OF TRADE-OFFS AMONG DESIGN, MANNING LEVELS AND OTHER LOGISTICS REQUIREMENTS TO MEET PROGRAM GOALS
- EVALUATION AND TESTING OF ADEQUACY OF PLANNED MANPOWER SUPPORT CONCEPTS AND RESOURCES TO MEET SYSTEM READINESS AND UTILIZATION OBJECTIVES
- AFFIRMATION OF THE ADEQUACY OF PLANNED MANPOWER TO MEET PEACETIME READINESS AND WARTIME EMPLOYMENT
- DOCUMENTATION OF PRELIMINARY MANNING AND SUPPORT ANALYSIS; NTP AND SMD/SOMD
- CONFIRMATION THAT MANPOWER REQUIREMENTS CAN BE MET FROM PROJECTED ASSETS

- CONTINUING EVALUATION AND ANALYSIS OF PLANNED MANPOWER
- REQUIREMENTS TO MEET SYSTEM READINESS GOALS

EXHIBIT App D-1. MPT Logistics Considerations in the Acquisition Process

developments. It also provides guidelines to ensure coordination of billets, personnel, military construction, training support, and training planning concurrent with hardware development and production.

The HARDMAN Methodology was designed as an enhancement to the NTP process, initiating the MPT planning process closer to the beginning of the acquisition process. This allows for the production of training planning data starting in the pre-Milestone I period. By doing so, HARDMAN makes possible the comparison of alternative training concepts and the early formulation of the training plan and training resource requirements. Once determined, this allows ample lead time to program for and acquire training resources, to formulate and establish the training program, and to train and detail personnel. Total training resource requirements to establish initial and follow-on training capability must be incorporated in the planning, programming, and budgeting process early during hardware development and made increasingly definitive as the system development progresses.

The key participants in the NTP process are defined in OPNAVINST 1500.8 as CNO, DCNO/DMSO Program Sponsor, Resource Sponsors, SYSCOMs, PMs and other Principal Development Activities (PDA). Exhibit App D-2 displays a flow chart of the NTP process and the roles of its major participants.

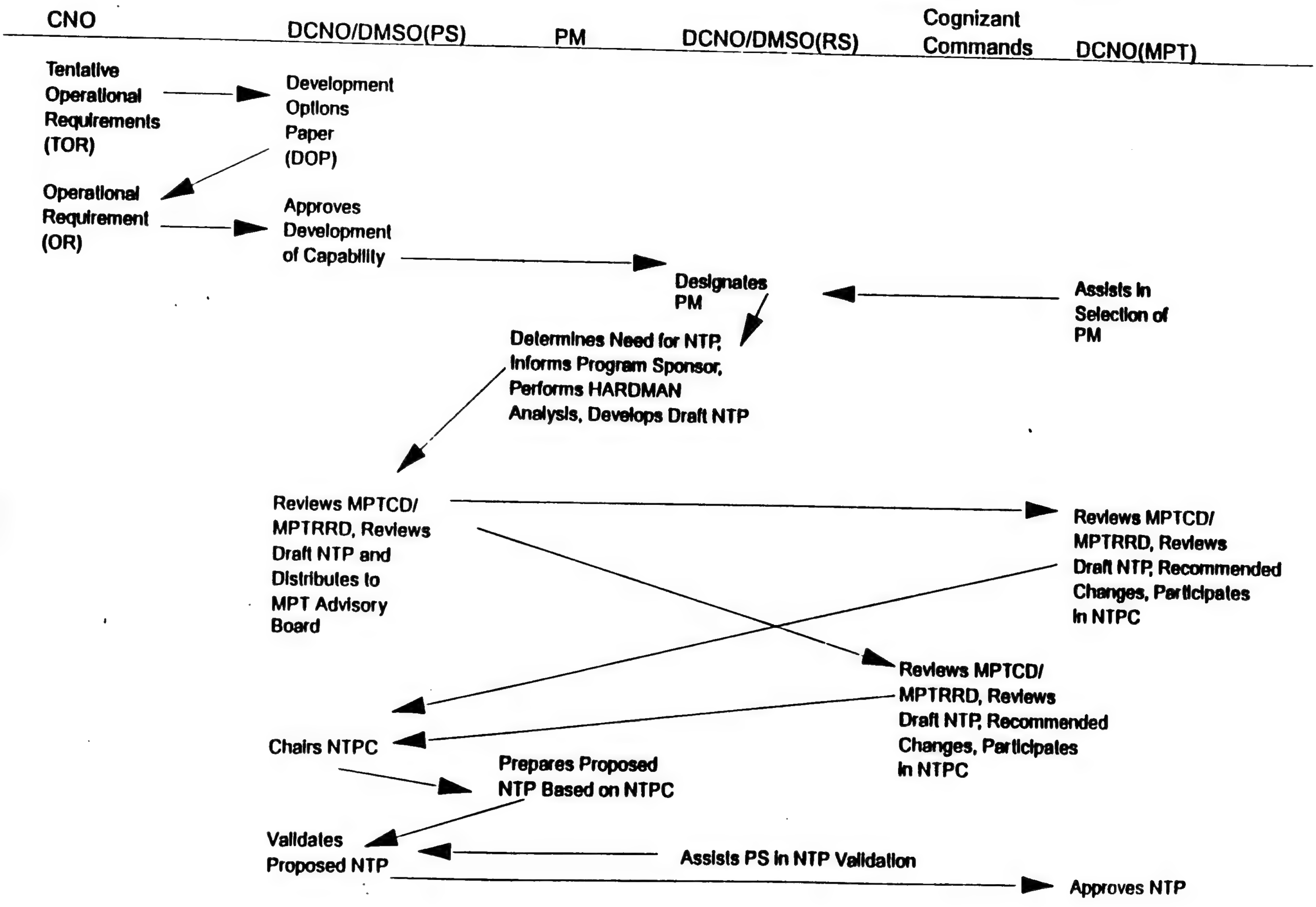


Exhibit App D-2. Navy Training Planning Process Flow Chart

## APPENDIX E

## HSI SYSTEM MANAGEMENT PLAN

Section 1 — Executive Summary. Provides an overview of HSI strategy and describes highlights of the Plan. HSI objectives and requirements are related to readiness, force structure, affordability, performance effectiveness, and achievement of operational objectives. The scope and purpose of HSI is described, as is a summary of HSI constraints and results of HSI analyses and trade-offs.

Section 2 — Description of the New Acquisition.

1. System Description: Defines essential total system performance characteristics and identifies where potential man-machine problem areas exist. This includes the following:

    a. General description of the system itself

    b. Major system components including form, fit, and function

    c. Missions to be performed

    d. Operational environments

    e. Alternative concepts or design

    f. Essential total system (human-in-the-loop) performance characteristics

    g. Techniques for integrating humans into the system

    h. Stage of system development at the time of HSISMP publication

2. Acquisition Strategy: Description of proposed or approved strategy including determination that the acquisition is a new development, MIL-SPEC procurement, non-developmental item (NDI), or product improvement. Indicates stage of development or initial acquisition phase if it is a new system development.

3. Activities Involved: This includes a complete list of all Headquarters Staff Offices, Headquarters Units, and other activities linked to HSI for this project. All activities are linked to the HSI Milestone Schedule in Tab B.

4. System Acquisition Milestones and Schedule: Includes due dates for key events linked to HSI Milestone Schedule contained in Tab B.

5. Guidance: Lists decisions made that will impact this acquisition, including the following:

   a. Prior decisions by Congress, the President, DoT, etc.

   b. General Coast Guard guidance

   c. Assumptions

   d. Mandated constraints

   e. Information relating to future personnel characteristics and force structure

Section 3 — HSI Issues and Constraints. This section identifies key issues that have HSI implications, including constraints established in MNS, and issues in major design, readiness, test and evaluation, and affordability. The requirement to document the management and resolution of HSI issues during the acquisition process makes the HSISMP a "living document" and establishes the requirement for an audit trail or program history. Section 3 includes the following specific areas:

1. Personnel Constraints

   a. End strength limitations

   b. Budget limitations

   c. Demographic limitations

   d. Requirements for reduced manning

   e. Constraints on crew size and mix

2. Personnel Availability

   a. Personnel availability estimates by skill level and source

   b. Budget limitations

3. Human Capability/Training Issues and Constraints

   a. Minimum skill level projection

   b. Constraints on personnel progression

   c. Constraints on training equipment and facilities

d. Requirements for special skills and cross training, embedded training, training devices, and training media

4. Human Performance Issues and Constraints

   a. Minimum acceptable human error rates

   b. Compatibility with and effects of automation on human skills and performance

   c. Team performance requirements

   d. Human performance limitations and capabilities as a function of proposed human-system interfaces (e.g., the effects and interaction of human fatigue and nuclear, biological, and chemical (NBC) protective equipment on human performance, system design, and manpower)

5. System Safety and Health Issues and Constraints

   a. Environmental constraints

   b. Limits to be placed on environmental factors

   c. Biomedical constraints

   d. Habitability constraints

Section 4 — HSI Program. This section includes activities, strategy, analyses results, test and evaluation, and relationships

1. HSI activities are those actions required for each acquisition phase. Examples include the following:

   a. Reductions in positions or requirements resulting from automation, design improvements, or cross training, expressed either in absolute terms or as compared with the predecessor system

   b. No increase in the characteristics and skills of operators, maintainers, or supporters; quantitative goals for personnel capabilities

   c. No increase in training hours from the predecessor system; use of advanced training technology or techniques, e.g., embedded training, intelligent tutoring, or interactive courseware training systems

   d. Establishment of an HFE program

   e. Establishment of system safety and health hazard control programs

2. HSI Strategy — This section reflects the system acquisition strategy and addresses the following:

   a. HSI risk assessment and reduction

   b. Application of advanced technology in the achievement of HSI objectives

   c. Reliance on commercial standards and data (e.g., American Society for Testing Materials (ASTM))

   d. Establishment of HSI priorities

   e. Description of the process to be implemented to ensure that HSI objectives are met

   f. Description of the approach for addressing HSI issues throughout the acquisition process

3. HSI Analyses — This indicates the analyses to be conducted and their effects on managing HSI risks. Annex Tab C contains information on data sources and includes the following types of analysis as examples:

   a. MAPTIDES

   b. Test Analysis

   c. Human Engineering Analysis

   d. System Safety Analysis

   e. Analysis of the predecessor system

4. HSI Analyses Results: Impacts on Design and Risk — This section includes a summary of the results of MPT, HFE, SS, HH, and other analyses accomplished in the Cost Benefit Analysis, for each alternative concept or design.

5. HSI Test and Evaluation — This is the definition of how the system T&E program will assess HSI domains in each phase of the acquisition process.

6. HSI Relationships — This section defines how HSI is organized within the acquisition program, how HSI will interact with the ILS and system engineering design programs, and a discussion of specific program relationships among the HSI domains.

Section 5 — HSI Tasks. These are the specific HSI Program tasks tailored for each acquisition. This section includes a description of each HSI Program task in terms of:

1. The specific tasks to be performed for this procurement

2. Required resources to complete each task - both funding and personnel

3. Time to complete each task

4. Responsible organization

5. Support organizations and their specific support being provided

6. Task flow dependencies (i.e., which tasks must be completed before others)

Section 6 — Products. A tailored listing of all HSI products, with descriptions of each HSI product in terms of:

1. Related task that produced the product from Section 5 above

2. Schedule for producing each product

3. Review authority

Section 7 — Tabs

Tab A — HSI Points of Contact: List of activities needed for HSI information and assistance, including the activities identified in Activities Involved section and those responsible for HSI tasks.

Tab B — HSI Milestone Schedule: Display of HSI tasks and products with schedule relationships to the acquisition process and the funding process.

Tab C — References and Data Sources: Listing of references and data sources used for the HSI effort; examples include acquisition documents (MNS, ORD, AP), T&E documentation, HSI data, predecessor and comparable systems analyses, and new technology descriptions.

Tab D — HSI Issues: List of issues that will influence HSI decisions. Includes a description of each issue, the responsible activity, proposed resolution date, and status.

Tab E — Target Audience Description (TAD): Addresses quantity, quality, and performance capabilities of future active duty/reserves/civilians/contractors who will operate, maintain, and support the new acquisition system.

1. The TAD is based on a compilation of requirements in each Coast Guard rating or officer specialty needed and similar civilian description of probable operators/maintainers/support personnel of this specific system.

2. It includes the numbers of people available now and expected in the future, aptitude scores required, mental category breakout, physical requirements, training currently provided, and high-driver tasks.

Tab F — Predecessor System(s): Defines the predecessor system(s) as well as delineates HSI lessons learned and high drivers from predecessor systems.

Tab G — HSI History or Audit Trail: Discussion of program decisions and events that have affected HSI in this specific acquisition. Significant HSI-related decisions made during all phases of the acquisition process should be documented.

## Appendix F

## Key HFE Issues in HSI Requirements Development

1. What effect does human performance have on system reliability?

2. Are the controls and displays laid out in a reasonable manner?

3. Does the system impose severe mental or physical demands on the operators?

4. Are emergency and warning signals adequate for catching the attention of the operators?

5. If the item under development is a subsystem, how does it affect the operation of other subsystems.

6. Are the controls and displays labeled adequately?

7. Are the controls laid out so that inadvertent activation will not cause any major problems?

8. Are there Atmospheric conditions that could affect the performance of the user-machine system?

9. Is there adequate lighting?

10. Does the operator need any special clothing or equipment to operate the system?

11. Is the system documentation written at a level that could be understood by the users?

12. Will vibration or acceleration have an adverse effect on system performance?

13. Are the control dynamics matched with human capabilities?

14. How will protective clothing affect the operation of the system?

15. What are the maximum impulse, noise, and blast overpressure levels that can be expected from this system?

16. Do the weights of any components that must be carried by Coast Guardsmen exceed applicable standards?

17. Are components that must be carried properly designed(e.g., have adequate handles?)

18. Does the system have room for stowage of the items necessary for extended surge operations?

19 Does the proposed system involve the introduction of a new technology?

20. HFE issues consider the capabilities and performance of user-machine combinations. Application of HFE in the design process involves consideration of HFE issues including but not limited to:

    a. Ingress/Egress

    b. Seating/Crew Station Geometry

    c. Open/Closed Hatch Vision

    d. Controls/Displays

    e. Lighting

    f. Environmental Control

    g. Crew or Unit Maintenance

## APPENDIX G

### Key SS/HH Issues in HSI Requirements Development

MIL-STD-882B, System Safety Program Requirements, is the seminal document that defines the key SS/HH domain issues that should be considered across the system development life-cycle. These requirements consist of two distinct classes of tasks that can be imposed on contractors on in-house development efforts that can be effectively tailored to Coast Guard acquisitions: (1) Program Management and Control tasks (Tasks 100 - 108), and (2) Design and Evaluation tasks (Tasks 210-213).

1. Program Management Tasks

| Task | Title |
|---|---|
| 100 | System Safety Program |
| 101 | System Safety Program Plan |
| 102 | Integration/Management of Associate Contractors, Subcontractors, and Architect and Engineering Firms |
| 103 | System Safety Program Reviews |
| 104 | System Safety Group/System Safety Working Group Support |
| 105 | Hazard Tracking and Risk Resolution |
| 106 | Test and Evaluation Safety |
| 107 | System Safety Progress Summary |
| 108 | Qualifications of Key Contractor System Safety Engineers/Managers |

2. Design and Evaluation Tasks

| Tasks | Title |
|---|---|
| 201 | Preliminary Hazard List |
| 202 | Preliminary Hazard Analysis |
| 203 | Subsystem Hazard Analysis |
| 204 | System Hazard Analysis |
| 205 | Operating & Support Hazard Analysis |

| | |
|---|---|
| 206 | Occupational Health hazard Analysis |
| 207 | Safety Verification |
| 208 | Training |
| 209 | Safety Assessment |
| 210 | Safety Compliance Assessment |
| 211 | Safety Review of ECPs and Waivers |
| 212 | — Reserved — |
| 213 | GFE/GFP System Safety Analysis |

MANPOWER ESTIMATE REPORT (FORMAT)[1]
(Program Title)

| | FYxx[2] | FYxx+1 | FYxx+2 | FYxx+3 | FYxx+4. . . . . . . .(Until Fielding Complete) |
|---|---|---|---|---|---|
| OPERATE:[3] | | | | | |
| Military | | | | | |
| Officers | | | | | |
| Enlisted | | | | | |
| Civilian | | | | | |
| Contractor | | | | | |
| MAINTAIN:[3] | | | | | |
| Military | | | | | |
| Officers | | | | | |
| Enlisted | | | | | |
| Civilian | | | | | |
| Contractor | | | | | |
| SUPPORT:[3] | | | | | |
| Military | | | | | |
| Officers | | | | | |
| Enlisted | | | | | |
| Civilian | | | | | |
| Contractor | | | | | |
| TRAIN:[3] | | | | | |
| Military | | | | | |
| Officers | | | | | |
| Enlisted | | | | | |
| Civilian | | | | | |
| Contractor | | | | | |
| TOTALS: | | | | | |

[1] Provide separate estimates by Active and Reserve Components.

[2] Begin with initial production and continue through full operational deployment. Estimates should be cumulative from fiscal year to fiscal year.

[3] Provide estimates for required billets/positions (or man-years for contractors) for each fiscal year.

**APPENDIX H**

# APPENDIX I

## MPT CONCEPT DEVELOPMENT FORMAT

Part I

A. Introduction

B. System Description (functional and physical)

C. System Requirements

D. Concept Summaries

E. Performance Goals and Standards

F. E/S/S Equipment and Functions

G. External Interfaces

H. E/S/S Configurations

I. Installation Schedule

Part II

A. Introduction

B. Manpower concept for E/S/S configuration(s) per representative platform/activity

1. Maintenance manpower

   a. Organizational level
   b. Intermediate level
   c. Depot level
   d. Other maintenance manpower

2. Operator manpower

   a. Operator
   b. Operator/maintainer

3. Other manpower (by activity)

## APPENDIX J

## NMRS MANPOWER PRODUCTS

The Navy Manpower Requirements System (NMRS) produces two principal products related to development of the Vessel Manpower Document (VMD). These are the NMRS working papers and the VMD itself. The working papers provide a summary of system inputs, functional transactions, variability factors, preliminary billet estimates and billet development, and watch station requirements. All NMRS manpower products are machine generated. For additional information on NMRS manpower products, refer to OPNAVINST 5310.19, Appendix C.

### WORKING PAPERS (VESSEL MANPOWER DOCUMENTS)

Section I - Workload/Watch Input Records
Section II - History of Workload/Watch Transactions
Section III - History of Standard/Variability Transactions
Section IV - Workload Distribution Report by Organization
Section V - Watch Station Assignments

### VESSEL MANPOWER DOCUMENT (VMD)

Forward

1. Introduction
2. Projected Operational Environment (POE)
3. Required Operational Capabilities Statement (ROC)
4. Definition of Terms

   A. Organizational Manning
   B. Operational Manning

      (1) Conditions of Manning Readiness
      (2) Special Conditions
      (3) Functional Readiness
      (4) Condition Watches

   C. Maintenance Manpower Requirements

      (1) Planned Maintenance (PM)
      (2) Corrective Maintenance (CM)
      (3) Facility Maintenance (FM)

   D. Own Unit Support Manpower Requirements (OUS)

      (1) Administrative Support

(2) Command Support
(3) Supply Support
(4) Medical Support
(5) Utility Task and Evolution

E. Customer Support Manpower Requirements (CS)

F. Manpower Factors

(1) Productive Allowance Factor (PA)
(2) Service Diversion Allowance and Training (SD&T)

TAB A Doctrinal Constraints
TAB B Navy Standard Workweek Afloat

5. Document Sections (Draft Format)

SECTION I — Officer Billet Summary

Billet Sec Number
Billet Title
Officer Rank
Officer Designator
Primary Naval Officer Billet Classification (NOBC)
Secondary NOBC
Sub Specialty Code
Additional Qualification Designator/Utilization Code (ADD/U)

SECTION II — Manpower Summary

Major Organizational Component
Number of Officers
Number of Enlisted
Number of Civilian

SECTION III — Manpower Requirements

Billet Sequence Number
Billet Title
Sub Specialty Code
AQD/U
Officer Designator/Minimum Rate/Rating for Billet
Primary NOBC
Secondary NOBC

SECTION IV — Battle Bill

Watch Station Number
Station Identification
Condition
- Division
- Minimum Rating and Paygrade
- NEC

SECTION V — Functional Workload

Function
Functional Hours Required
OMW Hours Available
OMW Hours Used
Functional Hours Distributed

SECTION VI (Part 01) — Summary of Officer Manpower Requirements

Designator
Paygrade

SECTION VI (Part 02) — Summary of Enlisted Manpower Requirements

Rating Group
Primary NEC
Secondary NEC
Paygrade

SECTION VI (Part 2a) — Summary of Enlisted Manpower Requirements by Dept.

Division
Rating
Primary NEC
Secondary NEC
Paygrade

SECTION VII — Summary of Organizational Manpower Requirements

(1) Organizational Manpower Requirements

- Officer
- CPO
- Other Enlisted

(2) General Apportionment of Enlisted Skills

- Petty Officers
- Designated Strikers
- Non-Rated Personnel

(3) Paygrade Distribution

<u>Appendices</u>

Appendix A Part 1 Maintenance Requirements/Table of Equipment Analysis

Part II Summary of PM Requirements by Division/Rating/Rate/NEC.

## APPENDIX K

## DETERMINATION OF DELTAS

Comparability analysis is based upon the determination of differences between the BCS and the new E/S/S, and how these differences affect the requirements for MPT resources created by the new E/S/S. These differences are the sources of change in MPT requirements between the BCS and the new E/S/S. Deltas are the estimated changes in BCS values, and their determination is central to effective comparability analysis.

A delta is calculated according to the following formula:

Delta Value = Existing BCS Value x Change Factor

The change factor is the anticipated value of the difference between the BCS and the new E/S/S. This could be, for example, a 10% increase in reliability or a 30% decrease in operating time.

In essence, the analyst is called upon to develop deltas for each area of MPT analysis appropriate to the program employing the MANTIDES Methodology. Each delta is determined based on the logical extension of the differences between the BCS and the new E/S/S. There is no hard and fast rule for developing deltas. The objective is to use the existing BCS value(s) and to determine an appropriate change factor. The change factor should reflect the way in which the BCS value is stated and the variety of physical features, design features, and system concepts inherent in the new E/S/S. In order to assist the analyst in understanding how deltas may be determined, several examples are given below. This is followed by a discussion of considerations that the analyst should be aware of in developing deltas.

## EXAMPLES OF DELTAS

**Example No. 1**

For purposes of this example, let us assume that the deltas we are determining result from anticipated mission differences between the BCS and the new E/S/S. In addition, let us assume that the BCS is operated only at general quarters, while, as a result of the mission difference, the new E/S/S will be operated 24 hours a day. As a result of these differences, maintenance deltas and operator skill deltas will have to be determined.

**Maintenance Deltas**

Deltas may be determined for all areas of MPT analysis.

<u>Preventive Maintenance (PM)</u> deltas may be determined in one of two ways, dependent upon how PM requirements are stated. If PM requirements are stated as a function of operating hours

then a delta is determined based upon a change to operating hours. For example, if the current mission requires the system to operate 20 hours per week, with a requirement for 0.1 hours of PM per operating hour, then the current PM requirement is two hours per week. If the mission of the new E/S/S requires 24 hours a day, 7 days a week operation with the same PM to operating hour ratio, a PM delta must be calculated. The first step is to calculate the change factor. In this case, the change factor equals the projected operating hours divided by the existing operator hours.

Change Factor = 168 hrs/wk / 20 hrs/wk = 8.4

The delta is then calculated to equal the existing PM hours per week, multiplied by the change factor.

PM Delta = 2 hrs/wk x 8.4 = 16.8 hrs/wk

The new PM requirement for this mission change would then be 16.8 hours per week.

PM requirements may also be established based on a cyclic pattern (i.e., weekly or monthly). Determination of deltas in this case is more subjective. Confer with design engineers and other subject matter experts to determine if the cyclic BCS PM schedule is satisfactory for the new E/S/S. If not, adjust the PM schedule to reflect the collective best estimate.

Corrective Maintenance (CM) requirements are determined based on two factors, mean time between failure (MTBF) of the equipment and mean time to repair (MTTR) those failures. Using the mission change example, and assuming an MTBF of 60 operating hours, the CM delta would be calculated in the following manner.

Existing CM actions per week equals existing operating time divided by MTBF.

20 operating hrs/wk / 60 operating hours = 0.33 existing CM actions/wk

The CM delta is then equal to the existing CM value multiplied by the change factor. The change factor as determined above is 8.4.

C Delta - 0.33 CM actions/wk x 8.4 = 2.8 CM actions/wk

CM hours required are then calculated by multiplying the number of CM actions per week by the MTTR.

CM hrs/wk = 2.8 CM actions/wk x 1.35 hrs/CM action = 3.78 hrs/wk

In this case, the new value would be 3.78 CM hours per week. This same figure could be calculated in fewer steps by multiplying the number of existing CM hours per week by the change factor.

$$\text{CM Delta} = 0.45 \text{ CM hrs/wk} \times 8.4 = 3.78 \text{ CM hrs/wk}$$

When historical CM data is not available, use an overall PM to CM ratio of 2:0, except for electronics, where a 1:1 ratio is used. This ratio includes CM-associated make-ready and put-away time.

**Operator Skill Deltas**

Operator skill deltas do not lend themselves to the quantitative analysis depicted above. These changes are related to operator skill requirements and involve a qualitative assessment of the suitability of existing rates, ratings, and special skills to operate in the modified functional environment. Operator skill related deltas should be determined as a result of an assessment of skill suitability based on occupational standards, and consultation with subject matter experts such as occupational specialists in the Office of Personnel and Training and rating technical advisors.

**Example No. 2**

Deltas related to changes in design and/or technology are a common cause of changes in system related MPT requirements. These deltas can take two major forms. First is a change in design and/or technology that eliminates existing tasks or creates new tasks. Second is a change in design and/or technology that modifies existing task frequency and/or duration.

When tasks have been eliminated, identify the number of hours required per week to perform that task and reduce the existing workload requirements by that value. Ensure that work load is associated with the proper rate, rating, and special skills. In general, the only instance in which an entire billet requirement will be deleted is when a watch station requirement has been eliminated.

Added tasks create a more complex problem. If there is no existing task with available performance data, then it is necessary to conduct task analysis. Task analysis is discussed in Step 2 of the HARDMAN Methodology (OPNAV P-111-1-87) as well as in MIL-STD-1388-1A and MIL-T-2905B, and is beyond the scope of this Appendix.

Changes to design and/or technology which affect the duration or frequency of existing tasks are calculated in much the same manner as described for PM and CM tasks affected by mission changes. The two principal factors which are used to denote these changes are reliability and maintainability. Reliability is often expressed in terms of MTBF. Thus an increase in reliability of 10 percent would increase the MTBF by 10 percent. In this case the change factor would be 1.1. The 10 percent is added to the unity value because it represents an increase in MTBF.

Maintainability is often expressed in terms of MTTR. Thus an increase in maintainability of 10 percent would decrease the MTTR by 10 percent. In this case the change factor would be 0.9; the 10 percent factor is given a negative value because it represents a decrease in MTTR.

The equations representing both a 10 percent increase in reliability and a 10 percent improvement in maintainability are as follows:

$$\text{MTBF Delta} = \text{Existing MTBF} \times 1.1$$

$$\text{MTTR Delta} = \text{Existing MTTR} \times 0.9$$

It is important to note that changes in reliability and maintainability may not always be applied to the entire system, but rather to components of it. If changes apply only to a component of the system under study, then deltas are calculated only for tasks associated with the changed component. These revised values are then added into the system total to determine the overall affect on system reliability and maintainability.

For example, a 90 percent improvement in reliability of a system component does not equate to a 90 percent change in reliability of the system unless that component accounts for 100 percent of system failures. If the component only accounts for 20 percent of system failures, the overall improvement in reliability equals only 18 percent (.9 improvement x .2 of system failures = .18). Thus, it is possible for a 25 percent improvement in reliability of a component, which accounts for 90 percent of system failures, to have greater impact on system reliability than an 80 percent improvement for a component which accounts for only five percent of system failures.

The analyst must ensure that such deltas are applied only to the proper tasks. Improved maintainability may reduce the duration of some maintenance tasks; however, it is most unlikely that make-ready and put-away time would be affected. All system deltas must be calculated with respect to individual tasks and then aggregated into a new system total.

## CONSIDERATIONS IN DEVELOPING DELTAS

### PHYSICAL FEATURES

1. Size, weight, volume, number of units, etc.: What are the changes made in this area? The number of personnel per task may be affected when considering the logistics of transporting or otherwise physically handling the units during operation or maintenance.

2. Location: Where are the subsystem units physically located? The number of personnel required to maintain or operate the subsystem may be affected if the units are spread out. Time to troubleshoot and/or repair is affected by accessibility.

## DESIGN FEATURES

### Electronic Design

1. New devices/components: What is the electronic state-of-the-art proposed for the new subsystem? What is the level of internal functional integration? The reliability or mean time between failures/corrective maintenance actions for the subsystem unit is often driven by the individual component reliabilities. Furthermore, maintenance concept and skill level may be affected.

2. Digital/analog: What functions are digital or analog? What are the interfaces? Reliability may be affected by changes in this area (e.g., digital circuitry is often more reliable than analog). Digital circuitry is generally more adaptable to modular design, which may result in faster and easier remove or replace actions. Planned maintenance time may be reduced by using digital circuits because analog devices often require more adjustment/alignment and performance checks. Troubleshooting time may be reduced because of the "go/no-go" aspects of digital circuits.

3. Modularity: What is the level of modular construction? What percentage of the subsystem/unit is modular? To what extent is the modularity standardized? Repair time may be reduced by increased modularity and standardization of modules and through increased use of remove/replace actions at the module rather than at the component level. Troubleshooting times may decrease because it often takes less time to isolate faults at the function/module level than at the component level.

### Mechanical Design

1. Accessibility: How long does it take operational/maintenance personnel to open inspection ports or to get into a unit? Operating delays and maintenance times may be affected by accessibility.

2. Complexity of moving major assemblies: What type of support equipment is required to move units? How easy is it to set up? To use? Maintenance times are the hours required to perform the repair, plus any support equipment manning required. In such cases, the number of people required for the task may be affected. Skill levels may be impacted.

3. Tolerances: How many procedures require alignment/adjustment to a given tolerance? How critical are the tolerances? How easy is it to achieve the given tolerance specifications? Corrective and planned maintenance times as well as operating delays may be affected. Skill levels also may be affected.

### General Design Characteristics

1. Special tools: What special tools are required? How complex are they to use? Troubleshooting, repair, and preventive maintenance times may be affected. Skill levels required may also be affected.

2. Special purpose test equipment (SPTE): What SPTE is required? How complex is it to use? What are its capabilities? Skill levels and maintenance times may be affected.

3. Built in test equipment (BITE): What BITE exists? What are its capabilities? How long to test? How effective is it? Higher skill levels are often required where BITE does not exist. Troubleshooting time may be reduced by increasing the BITE capabilities. The number of people required to maintain a subsystem could be a function of BITE if the units are diversely and remotely located.

## SYSTEM RELATED CONCEPTS

### Interface/Intercommunications

1. Software: How compatible is software between the subsystems? Software compatibility permits easier intercommunication between subsystems and possible function sharing. This may affect the number of operators required.

2. System hardware integration: To what extent do various subsystems share hardware functions such as controls and displays? Increased integration may lead to reductions in the number of operators because fewer operators can monitor and control more units from one location. Similarly, increased integration reduces the absolute numbers of units that might fail, thus permitting reductions in overall maintenance time or number of maintainers. Also, an improvement in system reliability is possible.

3. Central integrated test system (CITS): To what extent does CITS exist? What are its capabilities? CITS is conceived to be capable of monitoring the individual subsystem BITEs as well as possible signal/data degradation. It is centrally located, and when tied in with hardware and software integration concepts, may allow for a further reduction in personnel and a small increase in availability.

4. Computer aided maintenance/instruction (CAM/I): To what extent does this exist? CAM/I may reduce troubleshooting time by providing semi-automated logical and procedural troubleshooting aids. CAM/I can also help to reduce skill levels required for maintainers and operators.

5. Bussing: What type of bus system exists? Bussing, as opposed to traditional dedicated interconnections, allows for increased system integration. It permits a reduction in the number and complexity of wire runs. If fiber optic bussing techniques are used, interference problems are greatly reduced. In either case, bussing increases subsystem reliability and reduces maintenance times.

**Maintenance Concept**

The maintenance concept must be reviewed in sufficient detail to permit identification of task requirements of personnel responsible for the subsystem.

1. Organizational: What is the maintenance/sparing concept at the organizational level? This concept affects maintenance times, skill levels, and numbers of personnel required.

    a. Planned maintenance (PM): What are the PM requirements? (e.g., servicing, cleaning, lubricating, adjusting, etc.). How are the PMs instructed/performed? (e.g., proceduralized guides or manuals and training, etc.). How complex are the procedures? (e.g., are alignment or calibration procedures required?)

    b. Corrective maintenance (CM): How is a subsystem malfunction detected? Is it at organizational level or IMA/Depot level? If the replacement is repaired at the organizational level, how is the failed part isolated? To what level? Are automated test equipment, manual test equipment, general purpose test equipment and schematics, or proceduralized aids used? What special tools, skills, and knowledges are required to perform the repairs?

2. Intermediate: What is the maintenance philosophy for the given subsystem at this level? Turn-around times, number of personnel, and skill levels may be affected. Are any repair functions performed? If so, refer to the guide for organizational level maintenance. Is maintenance assistance to be provided to the organizational personnel from the IMA? Are IMA personnel required to have more in-depth knowledge of the subsystem or electronic principles? Does the IMA function as a supply (logistics) source for the organizational level? What other functions does the IMA provide for subsystem support (e.g., calibration, alignment, special tools, etc.)?

3. Depot: What functions does the depot activity provide in support of the subsystem? Are Navy, civil service or contractor personnel involved? Are training programs required? If so, these must be assessed in terms of the tasks performed and the skills and knowledge required to perform the tasks. What

support (spares, etc.) does the depot provide for the subsystem and what are the resultant manpower needs?

## Operations Concept

The operational manning concept must also be reviewed to identify the subsystem task requirements. Does the subsystem require operational manning? What is the manning frequency/period? What are the operational tasks and operator skill levels required? How is the subsystem operated (e.g., remote or local)? Is more than one location used simultaneously? What is the operator task loading and what are the human engineering factors?

## APPENDIX L

## HSI JOINT WORKING GROUP

1. As needed, the OHSIP should form a Coast Guard HSI/Joint-Working Group (JWG) to advise on all aspects of identifying, analyzing, resolving, and documenting HSI issues encountered in meeting the goal of fully integrating all HSI domains into each system acquisition. This joint working group is made up of Coast Guard organizations that may not otherwise be directly involved in the acquisition process, but who have expertise and data applicable to one or more HSI domains. Inputs from such organizations are invaluable to OHSIP in attempting to focus the most rigorous advise available to the Coast Guard in making long-range predictions and projections concerning HSI domain issues in individual acquisitions.

2. The exact composition of the working group is based on assets available and the type of acquisition conducted (e.g., the design and development of information resource management equipment would require a different membership than the acquisition of a helicopter or a cuter). Membership should be selected from the following organizations:

a. Office Responsible for HSI Program — Convenes as required and Co-chairs the HSIJWG

b. Sponsor — Co-chairs HSIJWG when convened

c. Human Factors Engineering Proponent

d. Manpower Proponent

e. Personnel Proponent

f. Training Developer

g. System Safety/Health Hazards Proponent

h. Integrated Logistics Support (ILS) Developer

i. Project Manager (PM)

j. Other organizations as appropriate

3. Interface between OHSIP and HSIJWG. When the joint working group is formed for an acquisition, the OHSIP uses assigned domain expertise and does most of the HSI planning, analyses, testing, and follow-up with assistance as needed from the HSIJWG.

a. Responsibilities for HSI

(1) The HSIJWG supports the HSI Program by:

a. Assisting OHSIP as requested in identifying, analyzing, resolving, and documenting all HSI issues in each acquisition.

b. Bringing together institutional organizations who maintain data bases hand have functional expertise that may be needed by OHSIP to properly execute the HSI Program. The joint working group provides a forum to coordinate access to this information and expertise; it also provides a forum with all the appropriate staff experts as members to review and advise on plans and completed analyses and to assess impacts on the total Coast Guard, etc.

(2) The OHSIP supports the HSI Program by: Refer to OHSIP responsibilities in Section C under paragraph 4.1.a.(2). In addition, OHSIP provides training to the HSIJWG when the group is formed and for any new members.

b. Exchange of Necessary Information/Data/Documents/Etc.

(1) Inputs from the HSIJWG to OHSIP

(a) Program guidance and constraints known to joint working group members that impact HSI domains

(b) Data from members with institutional data bases, such as manpower planning data and personnel data describing characteristics for use in the TAD and the amount/kind of training currently received by ratings/pay grades of interest, etc.

(c) Review HSI plans, completed analyses, and other HSI documentation as requested

(2) Inputs from OHSIP to the HSIJWG

(a) OHSIP convenes and acts as co-chair of the HSIJWG

(b) OHSIP submits HSI plans, analyses, and documentation to the HSIJWG for review as required

c. Coordination/Communications Required

(1) OHSIP is the principal participant in setting up the HSIJWG, developing the agenda, and coordinating all activities of the group.

(2) As requested, the HSIJWG reviews and provides feedback to OHSIP on the adequacy of all HSI plans, studies, analyses, and documentation.